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DEPARTURES FROM LOCAL THERMODYNAMIC EQUILIBRIUM IN AN AO STAR ATMOSPHERE

by Myron Lecar

Goddard Institute for Space Studies
New York, N. Y.

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SUMMARY

By comparison with an accurate model, departures from local thermodynamic equilibrium (LTE) have been evaluated for model atmospheres in radiative equilibrium, approximating an AO star (pure hydrogen, $T_{eff.} = 10^4 \text{ } ^\circ\text{K}$, $g = 10^3$ and 10^4 cm sec^{-2}). The non-LTE atomic populations depress the emergent flux in the Lyman continuum and in the lines by 10-30 percent, but the Balmer and higher continua are unaffected. Thus the temperature stratification is unchanged. The emergent flux in the center of the lines is insensitive to replacing a 5-point quadrature over a Doppler profile by the central intensity. At the surface, the lowest three bound states are overpopulated, the higher bound states are underpopulated, and the degree of ionization is reduced by a factor of 2 with respect to LTE. The populations converge to their LTE values at $\tau_{Rosseland} = 10^{-3}$. The steady state populations are unchanged by increasing the collisional rates by a factor of 100 or dropping them altogether.



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List of Symbols

<i>superscript</i> (°)	denotes equilibrium value
<i>superscript</i> *	ratio of quantity to its equilibrium value
<i>a</i> [gm cm ⁻²]	$m_H x^{-1}$
<i>a_o</i> [cm]	Bohr radius = 5.292×10^{-9}
<i>A_{j i}</i> , <i>A_{k i}</i> [sec ⁻¹]	Einstein coefficient of spontaneous emission
$\tilde{A}_{k i}$ [sec ⁻¹]	renormalized <i>A_{k i}</i>
<i>B_{i j}</i> , <i>B_{i k}</i> [cm ² erg ⁻¹ sec ⁻¹]	Einstein coefficient of absorption
<i>B_{j i}</i> , <i>B_{k i}</i> [cm ² erg ⁻¹ sec ⁻¹]	Einstein coefficient of induced emission
$\tilde{B}_{i k}$ [cm ² erg ⁻¹ sec ⁻¹]	renormalized <i>B_{i k}</i>
$\tilde{B}_{k i}$ [cm ² erg ⁻¹ sec]	renormalized <i>B_{k i}</i>
β [erg ⁻¹]	$(kT)^{-1}$
<i>c</i> [cm sec ⁻¹]	speed of light = 2.998×10^{10}
<i>c_e</i> [sec ⁻¹]	rate of electron-electron collisions
<i>c_{i j}</i> , <i>c_{i k}</i> [sec ⁻¹]	collisional transition rate
cps [sec ⁻¹]	cycles per second
<i>e</i> [esu]	charge of electron = 4.803×10^{-10}
<i>E_i</i> [ergs]	energy of <i>i</i> th bound state
<i>E_k</i> [ergs]	energy of <i>k</i> th continuous state
ϵ_{ν} [ergs cm ⁻³ sec ⁻¹ cps ⁻¹]	volume emission coefficient
<i>F_ν</i> [ergs cm ⁻² sec ⁻¹ cps ⁻¹]	monochromatic net flux
<i>F</i> [ergs cm ⁻² sec ⁻¹]	integrated net flux
<i>g</i> [cm sec ⁻²]	gravitational acceleration
Γ []	collision parameter
<i>h</i> [erg sec]	Planck's constant = 6.625×10^{-27}
\hbar [erg sec]	$h/2\pi$
<i>i</i> []	index for bound state
<i>I_ν</i> [ergs cm ⁻² sec ⁻¹ cps ⁻¹]	monochromatic specific intensity
<i>I</i> [ergs cm ⁻² sec ⁻¹]	integrated specific intensity

J_ν [ergs cm ⁻² sec ⁻¹ cps ⁻¹]	monochromatic mean intensity
J [ergs cm ⁻² sec ⁻¹]	integrated mean intensity
k [erg deg ⁻¹ K]	Boltzmann's constant = 1.380×10^{-16}
K_ν [cm ⁻¹]	monochromatic absorption coefficient
K [cm ⁻¹]	mean absorption coefficient
k_ν []	K_ν/K
k []	index for continuous state
λ [cm]	thermal De Broglie wavelength = $(h^2/2\pi mkT)^{1/2}$
Λ [cm]	mean free path
m [gm]	mass of electron = 9.108×10^{-28}
m_H [gm]	mass of hydrogen atom = 1.673×10^{-24}
N [cm ⁻³]	number density of nuclei
N_e [cm ⁻³]	number density of electrons
N_γ [cm ⁻³]	number density of photons
N_i [cm ⁻³]	number density of atoms in the i^{th} bound state
N_0 [cm ⁻³]	number density of neutral atoms
n_i [cm ³]	N_i/N_e^2
ν []	frequency in units of R
p [dynes cm ⁻²]	gas pressure
p_{ij}, p_{ik} [sec ⁻¹]	transition rate
ϕ [cm ³ erg ⁻¹]	$\beta l^3 e^{U_H}$
Q []	collision cross-section in units of πa_0^2
R [sec ⁻¹]	Rydberg constant = 3.290×10^{15}
r_{ij}, r_{ik} [sec ⁻¹]	radiative transition rate
ρ [gm cm ⁻³]	gas density
S_ν [erg cm ⁻² sec ⁻¹ cps ⁻¹]	monochromatic source function
S [erg cm ⁻² sec ⁻¹]	integrated source function

σ_{ij} , σ_{ik} [cm ²]	collision cross-section
σ [erg cm ⁻² deg ⁻⁴ K]	Stefan-Boltzmann constant
T [°K]	temperature
U_i []	$\beta E_i $
U_H []	$\beta E_1 $
U_k []	βE_k
v [cm sec ⁻¹]	velocity
W []	dilution factor
x_ν [cm ²]	monochromatic absorption cross-section
\bar{x} [cm ²]	mean absorption cross-section

DEPARTURES FROM LOCAL THERMODYNAMIC EQUILIBRIUM IN AN AO STAR ATMOSPHERE

(Manuscript Received July 15, 1963)

by
Myron Lecar
Goddard Institute for Space Studies

Chapter 1 **INTRODUCTION**

Spectroscopic analysis of the radiation from a star yields a rich store of data from which can be inferred the chemical composition, temperatures and pressures in the outer layers of the star. In order to translate the observed spectrum into a physical model of the outer layers, a number of model atmospheres are constructed for assumed values of the chemical composition, the total energy of emitted radiation and the surface gravity. The correct model is selected by matching the computed to the observed spectrum.

In constructing model atmospheres, current practice relies heavily on the assumption of local thermodynamic equilibrium (LTE). The hypothesis of LTE asserts that the *local* physical condition of the radiating gas can be adequately described by the formulae of *equilibrium* statistical mechanics, i.e. that a local temperature can be assigned to the gas. Thereby an enormous simplification is achieved because for a given chemical composition the frequency dependence of the emission and absorption coefficients becomes a function of only two parameters, the local pressure and temperature. It is important to recognize that the assumption of local thermodynamic equilibrium cannot be carried over to the radiation field; for the equations of radiative transfer would then demand that the atmosphere have the same temperature throughout.

Thus, if the assumption of LTE is not to introduce inconsistency, the two components of the atmosphere, the gas and the radiation, must interact in such a manner as to preserve the local equilibrium character of the gas, while allowing the radiation field to exhibit non-equilibrium character; in particular, the transfer mechanism must generate progressive reddening of the radiant flux as it approaches the stellar surface.

Physical intuition suggests that the atoms should relax to an equilibrium distribution when collisional transitions outweigh radiative encounters and when the temperature gradient over a collisional mean free path is sufficiently small. The latter condition is easily satisfied, but the former is frequently violated in stellar atmospheres. The atoms should likewise maintain a

near-equilibrium distribution wherever the non-equilibrium component of the radiation field, i.e. the flux, is a small fraction of the local intensity of radiant energy. This condition is never satisfied right at the surface of a star, in the very layers where the strong absorption lines are formed.

Exactly where the approximation of LTE breaks down can only be determined by a detailed kinetic analysis of the steady state which takes into account all the radiative and collisional transitions. Such kinetic studies have indeed been carried out but what has not been attempted hitherto is a self-consistent treatment of the problem, combining the kinetic analysis of the steady state at each level of the atmosphere with a simultaneous evaluation of the temperature stratification; in previous analyses either the temperature stratification or the radiation field was pre-specified. Accordingly, it seemed desirable to undertake the construction of a model atmosphere which embodies a complete kinetic study of the atomic populations of the major sources of opacity.

The model selected corresponds to an AO star (effective temperature 10^4 °K, surface gravity 10^3 and 10^4 cm sec $^{-2}$). For these parameters, the dominant source of opacity is atomic hydrogen, whose radiative and collisional cross-sections are known to greater accuracy than those of any other atomic species. It was a major aim of this investigation to set, for the first time, precise numerical limits to the departures from LTE in stellar atmospheres. Hence, it was necessary to attend to computational rigor until possible departures from LTE were certain not to be obscured by numerical inaccuracies.

Previous work on kinetic analyses of the steady state in gaseous nebulae and in the solar chromosphere, respectively, are contained in References 1 and 2.

Chapter 2

OUTLINE

The evaluation of the departures from LTE involves a sequence of calculations which are summarized in this chapter. The investigation is divided into three parts.

1. The determination of the temperature distribution in an atmosphere in radiative equilibrium, *assuming LTE*.
2. The calculation of the *steady state* atomic populations, using the radiation fields, electron densities, and temperatures of the LTE model atmosphere.
3. The comparison of the steady state with the LTE atomic populations at each level in the atmosphere, and the evaluation of changes in the atmosphere caused by the departures of the steady state populations from their LTE values.

These three topics are taken up in detail in chapters 3, 4, and 5 respectively; the most important equations are collected in this chapter.

For a model atmosphere typifying a main sequence AO star, the following approximations are applicable.

1. Spherical Symmetry

The radiation field at any point r (measured from the center of the star) depends only on the distance from the center of the star (r).

2. The linear extent of the atmosphere (Δr) is small compared to the stellar radius (R).

a. Plane Stratification

Since $\Delta r/R \ll 1$, the radius of curvature at the level of the atmosphere can be taken as infinite, and the atmosphere can be treated as if it were stratified in plane parallel layers. The normal to the plane of stratification is defined as the Z -axis, with the positive Z -direction towards the surface of the star. The assumption of spherical symmetry reduces to cylindrical symmetry about the Z -axis.

b. Constant Gravitational Acceleration

Since $\Delta r/R \ll 1$, the gravitational acceleration (which varies as r and the mass interior to r) can be assumed constant throughout the atmosphere.

3. Steady State

The physical parameters of the atmosphere are constant in time.

4. Radiative Equilibrium

The predominant mechanism for energy transfer is assumed to be radiative transfer, i.e. conduction and convection are neglected. Combined with the assumption of a steady state, this requires the net flux of radiation to be strictly a constant both in position and time.

5. Hydrostatic Equilibrium

To insure against macroscopic mass motions, the pressure gradient (or buoyancy force) must exactly balance the gravitational acceleration, i.e.

$$-\frac{dp}{dz} = g\rho ,$$

where ρ is the gas pressure in dynes/cm², g is the gravitational acceleration in cm sec⁻² and ρ is the density in grams/cm³. Radiation pressure is neglected entirely.

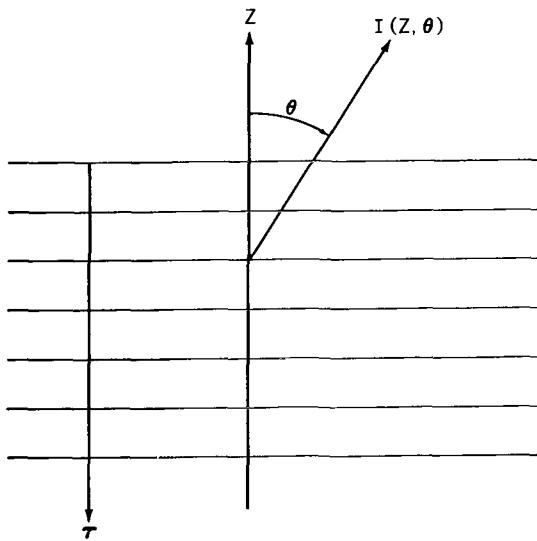
In addition, in computing the opacity, electron scattering and line blanketing are neglected. Also, for simplicity we assume that the only chemical constituent of the atmosphere is hydrogen.

Subject to these restrictions, the atmosphere is completely specified by the gravitational acceleration and the net flux.

The geometry of the atmosphere is pictured below.

The equation of transfer for the monochromatic specific intensity is

$$\mu \frac{\partial I_\nu(z, \mu)}{\partial z} = -K_\nu I_\nu + \epsilon_\nu , \quad (1)$$



where

$$\mu = \cos \theta$$

I_ν = monochromatic specific intensity
(ergs/cm² sec cps steradian)

K_ν = absorption coefficient (cm⁻¹)

ϵ_ν = emission coefficient
(ergs/cm³ sec cps steradian).

Introducing the monochromatic optical depth $\tau_\nu(z)$, which is defined by

$$\tau_\nu(z) = - \int_z^\infty K_\nu(z') dz' , \quad (2)$$

the equation of transfer may be written

$$\mu \frac{\partial I_\nu(\tau_\nu, \mu)}{\partial \tau_\nu} = I_\nu - S_\nu , \quad (3)$$

where $S_\nu = \epsilon_\nu/K_\nu$ is called the "Source Function." It is sometimes convenient to refer the monochromatic optical depth to a mean optical depth τ , defined by

$$\tau(z) = - \int_{\infty}^z K(z) dz , \quad (4)$$

where K is a mean absorption coefficient independent of frequency. Then, $\tau_\nu(\tau)$ is determined from

$$\tau_\nu(\tau) = \int_0^\tau k_\nu(t) dt \quad (5)$$

where $k_\nu = K_\nu/K$.

The equation of transfer may also be written

$$\mu \frac{\partial I_\nu(\tau, \mu)}{\partial \tau} = k_\nu (I_\nu - S_\nu) . \quad (6)$$

Two moments of I_ν with respect to μ are of primary interest; J_ν the mean intensity, and F_ν , the net flux.

$$J_\nu(\tau) = \frac{1}{2} \int_{-1}^{+1} I_\nu(\tau, \mu) d\mu , \quad (7)$$

$$F_\nu(\tau) = 2 \int_{-1}^{+1} I_\nu(\tau, \mu) \mu d\mu . \quad (8)$$

If Equation 6 is operated on with $\frac{1}{2} \int_{-1}^{+1} d\mu$ we obtain

$$\frac{\partial F_\nu}{\partial \tau} = 4k_\nu (J_\nu - S_\nu) , \quad (9)$$

where S_ν is assumed independent of μ .

Integrating Equation 9 over frequency yields

$$\frac{\partial F}{\partial \tau} = 4 \int_0^{\infty} d\nu k_\nu (J_\nu - S_\nu) . \quad (10)$$



In radiative equilibrium, $F = \text{constant}$ and

$$\int_0^\infty d\nu k_\nu J_\nu = \int_0^\infty d\nu k_\nu S_\nu , \quad (11)$$

which states that the total amount of radiant energy absorbed locally is equal to that emitted.

The equation of transfer (Equation 6) can be formally integrated to yield $I_\nu(\tau, \mu)$ as a function of $S_\nu(\tau)$ and μ . We can also obtain the moments of the formal integrals of I_ν , i.e. J_ν and F_ν . Employing the boundary condition that there be no incident radiation at $\tau = 0$, the formal integrals for J_ν and F_ν are

$$J_\nu(\tau) = \frac{1}{2} \int_0^\infty dt_\nu S_\nu(t_\nu) E_1(|t_\nu - \tau_\nu|) \quad (12)$$

and

$$F_\nu(\tau) = 2 \int_{\tau_\nu}^\infty dt_\nu S_\nu(t_\nu) E_2(t_\nu - \tau_\nu) - 2 \int_0^{\tau_\nu} dt_\nu S_\nu(t_\nu) E_2(\tau_\nu - t_\nu) , \quad (13)$$

where

$$dt_\nu = k_\nu(t) dt$$

$$t_\nu = t_\nu(t) , \quad \tau_\nu = t_\nu(\tau)$$

$$E_n(x) = \int_1^\infty e^{-x\xi} \frac{d\xi}{\xi^n} \text{ is the } n^{\text{th}} \text{ exponential integral.}$$

It is instructive to expand $S_\nu(t_\nu)$ in a Taylor Series about $S_\nu(\tau_\nu)$. One obtains

$$J_\nu(\tau) = \frac{1}{2} \sum_{n=0}^{\infty} \frac{S_\nu^{(n)}(\tau)}{n+1} \left\{ [1 + (-1)^n] + (-1)^{n+1} (n+1) \xi_n^{(2)}(\tau_\nu) \right\} , \quad (14)$$

$$F_\nu(\tau) = 2 \sum_{n=0}^{\infty} \frac{S_\nu^{(n)}(\tau)}{n+2} \left\{ [1 - (-1)^n] + (-1)^{n+1} (n+2) \xi_n^{(3)}(\tau_\nu) \right\} , \quad (15)$$

where

$$S_{\nu}^{(n)}(\tau) = \frac{d^{(n)} S_{\nu}(t_{\nu})}{dt_{\nu}^{(n)}} \Big|_{t_{\nu}=\tau_{\nu}},$$

$$\xi_n^{(a)}(\tau_{\nu}) = \sum_{l=0}^n \frac{\tau_{\nu}^l}{l!} E_{n-l+a}(\tau_{\nu}).$$

As $\tau_{\nu} \rightarrow 0$ and as $\tau_{\nu} \rightarrow \infty$, Equations 14 and 15 reduce to

$$J_{\nu}(\tau) = \frac{1}{2} S_{\nu} + \frac{1}{4} S_{\nu}^{(1)} + \frac{1}{6} S_{\nu}^{(2)} + \dots, \quad (16)$$

$\tau_{\nu} \rightarrow 0$

$$F_{\nu}(\tau) = \frac{2}{2} S_{\nu} + \frac{2}{3} S_{\nu}^{(1)} + \frac{2}{4} S_{\nu}^{(2)} + \dots, \quad (17)$$

and

$$J_{\nu}(\tau) = S_{\nu} + \frac{1}{3} S_{\nu}^{(2)} + \frac{1}{5} S_{\nu}^{(4)} + \dots, \quad (18)$$

$\tau_{\nu} \rightarrow \infty$

$$F_{\nu}(\tau) = \frac{4}{3} S_{\nu}^{(1)} + \frac{4}{5} S_{\nu}^{(3)} + \frac{4}{7} S_{\nu}^{(5)} + \dots. \quad (19)$$

If we retain only the leading term in the expansion for F_{ν} , and the leading two terms in the expansion for J_{ν} we obtain as $\tau_{\nu} \rightarrow \infty$

$$F_{\nu}(\tau) = \frac{4}{3} S_{\nu}^{(1)}(\tau), \quad (20)$$

and remembering that $d/d\tau = k_{\nu} d/d\tau_{\nu}$,

$$\frac{dF_{\nu}(\tau)}{d\tau} = \frac{4}{3} k_{\nu}(\tau) S_{\nu}^{(2)}(\tau) = 4k_{\nu}(\tau) [J_{\nu}(\tau) - S_{\nu}(\tau)], \quad (21)$$

which is Equation 9. This suggests, but by no means proves, that the third and higher derivatives vanish at large optical depth. This does turn out to be the case in the model atmosphere treated in this investigation.

Returning to the formal integral for the monochromatic net flux (Equation 13) and integrating this equation over frequency we obtain an integral equation for the unknown source function, namely

$$F = 2 \int_0^{\infty} d\nu \left[\int_{\tau_{\nu}}^{\infty} dt_{\nu} S_{\nu}(t_{\nu}) E_2(t_{\nu} - \tau_{\nu}) - \int_0^{\tau_{\nu}} dt_{\nu} S_{\nu}(t_{\nu}) E_2(\tau_{\nu} - t_{\nu}) \right], \quad (22)$$

where F is a given constant. This, together with Equation 5,

$$t_\nu(t) = \int_0^t k_\nu(s) ds , \quad (23)$$

relates the two unknown functions, k_ν and s_ν (or K_ν and ϵ_ν) to the boundary condition $F = \text{constant}$.

We now proceed to show that for a given chemical composition, K_ν and ϵ_ν , are fully determined by specifying the atomic populations, and that in the special case of a pure hydrogen atmosphere in LTE, k_ν and s_ν depend only on the temperature.

The discussion will be facilitated, if, at this time, we introduce some notation. First, the frequency ν is given in units of R , the Rydberg constant in frequency units, where

$$R = \frac{me^4}{4\pi\hbar^3} = 3.290 \times 10^{15} \text{ sec}^{-1}$$

$$m = \text{mass of electron} = 9.108 \times 10^{-28} \text{ gm}$$

$$e = \text{charge of electron} = 4.803 \times 10^{-10} \text{ esu}$$

$$h = \text{Planck's constant} = 6.625 \times 10^{-27} \text{ erg sec}$$

$$\hbar = h/2\pi = 1.054 \times 10^{-27} \text{ erg sec.}$$

Note that the frequency ν is thus dimensionless.

Specializing to hydrogen, $\nu = 1$ is the frequency at the head of the Lyman continuum, and $\nu = 1/i^2$ is the frequency at the head of the i^{th} continuum.

The energy of the i^{th} bound state is

$$E_i = -\frac{hR}{i^2} . \quad (24)$$

Denoting $1/kT$ by β , where k is the Boltzmann constant and T is the temperature, we write

$$-\frac{E_i}{kT} = -\beta E_i = U_i . \quad (25)$$

For an unbound state, we write in analogy to Equations 24 and 25

$$E_k = \frac{1}{2}mv^2 = \frac{hR}{k^2} \quad (26)$$

and

$$\frac{E_k}{kT} = \beta E_k = U_k , \quad (27)$$

where v is the velocity. Thus, the threshold energy for a transition between two bound states i and j , and between a bound state i and a continuum state k , is written

$$hR \nu_{ij} = hR \left(\frac{1}{i^2} - \frac{1}{j^2} \right) , \quad (28)$$

and

$$hR \nu_{ik} = hR \left(\frac{1}{i^2} + \frac{1}{k^2} \right) . \quad (29)$$

Notice that $U_{ij} = U_i - U_j$ and $U_{ik} = U_i + U_k$.

The physical interpretation of ϵ_ν and K_ν is simplest for a transition between two bound states (i.e. a line transition) and although these transitions are neglected in the computation of the opacity, they will be used in the calculation of the steady state populations.

Consider a transition between a lower bound state i and an upper bound state j . For frequencies in the line profile ($\nu \approx \nu_{ij}$) the emission and absorption coefficients can be written (Reference 3).

$$4\pi\epsilon_\nu = N_j A_{ji} hR\nu \phi(\nu) , \quad (30)$$

$$4\pi K_\nu = (N_i B_{ij} - N_j B_{ji}) hR\nu \phi(\nu) , \quad (31)$$

where

$N_i [\text{cm}^{-3}]$ = number of atoms/cm³ in the i^{th} bound state

$A_{ji} [\text{sec}^{-1}]$ = Einstein coefficient of spontaneous emission

$B_{ij} [\text{cm}^2 \text{erg}^{-1} \text{sec}^{-1}]$ = Einstein coefficient of absorption

$B_{ji} [\text{cm}^2 \text{erg}^{-1} \text{sec}^{-1}]$ = Einstein coefficient of induced emission

$\phi(\nu) [\text{sec}]$ = normalized absorption profile

$$\int_{-\infty}^{+\infty} \phi(\nu) d(R\nu) = 1 .$$

Note that the Einstein coefficients are normalized for the intensity (rather than the density) of radiant energy. The Einstein coefficients are related as follows:

$$A_{ji} = \frac{2hR^3 \nu^3}{c^2} \frac{\bar{\omega}_i}{\bar{\omega}_j} B_{ij} , \quad (32)$$

$$B_{ji} = \frac{\bar{\omega}_i}{\bar{\omega}_j} B_{ij}, \quad (33)$$

where $\bar{\omega}_i$ = statistical weight of i^{th} state = $2i^2$ for hydrogen. B_{ij} can be calculated from

$$B_{ij} = \frac{4\pi}{hR\nu} \frac{\pi e^2}{mc} f_{ij} \quad (34)$$

and

$$f_{ij} = \frac{64}{3^{3/2}\pi} \frac{1}{\bar{\omega}_i} \frac{1}{i^3} \frac{1}{j^3} g_{ij}, \quad (35)$$

where the $g_{ij} \approx 1$ and is given by Menzel and Pekeris (Reference 3).

In thermodynamic equilibrium, the number of radiative transitions from the i^{th} to the j^{th} state must be balanced by an equal number of inverse transitions. Thus

$$N_i B_{ij} B_{\nu_{ij}} = N_j (A_{ji} + B_{ji} B_{\nu_{ij}}), \quad (36)$$

where B_ν is the radiative intensity in thermodynamic equilibrium:

$$B_\nu = \frac{2hR^3 \nu^3}{c^2} (e^U - 1)^{-1}. \quad (37)$$

Inserting Equation 37 for B_ν , we find that in thermodynamic equilibrium

$$\frac{N_i}{N_j} = \frac{\bar{\omega}_i}{\bar{\omega}_j} e^{U_{ij}} = \frac{\bar{\omega}_i}{\bar{\omega}_j} \frac{e^{U_i}}{e^{U_j}} = \frac{\bar{\omega}_i}{\bar{\omega}_j} \frac{e^{-\beta E_i}}{e^{-\beta E_j}}, \quad (38)$$

which is the Boltzmann relation.

Now consider a transition between a bound state i and a continuous state k . If we assume that the velocity distribution of the continuous state is Maxwellian, the contribution of this transition to the emission and absorption coefficients can be written

$$4\pi\epsilon_\nu = N_e^2 l^3 e^{-U_k} \tilde{A}_{ki} hR\nu \frac{dk}{d(R\nu)}, \quad (39)$$

$$4\pi K_\nu = \left(N_i \tilde{B}_{ik} - N_e^2 l^3 e^{-U_k} \tilde{B}_{ki} \right) hR\nu \frac{dk}{d(R\nu)}, \quad (40)$$

where: N_e [cm⁻³] = number of electrons per unit volume = number of ions per unit volume,

$$l \text{ [cm]} = \left(\frac{h^2}{2\pi mkT} \right)^{1/2}, \quad (41)$$

$$\frac{dk}{d(R\nu)} = \frac{k^3}{2R}, \quad (42)$$

$$\tilde{A}_{ik} = \frac{2hR^3 \nu^3}{c^2} \tilde{B}_{ik} \frac{\bar{\omega}_i}{2}, \quad (43)$$

$$\tilde{B}_{ik} = \tilde{B}_{ik} \frac{\bar{\omega}_i}{2}, \quad (44)$$

$$\tilde{B}_{ik} = \frac{4\pi}{hR\nu} \cdot \frac{\pi e^2}{mc} f_{ik}, \quad (45)$$

$$f_{ik} = \frac{64}{3^{3/2}\pi} \frac{1}{\bar{\omega}_i} \frac{1}{i^3} \frac{1}{k^3} g_{ik}, \quad (46)$$

and we set $g_{ik} = 1$.

Again, in thermodynamic equilibrium, by an argument identical to that leading to Equation 38 we find

$$\frac{N_i}{N_e^2} = \frac{\bar{\omega}_i}{2} l^3 e^{U_i}, \quad (47)$$

which is the Boltzmann-Saha Equation.

Note that we have made explicit use of the facts that the velocity distribution is Maxwellian and that the number of ions equals the number of electrons. Both of these assumptions are made in the present investigation. We shall justify the first assumption later in this chapter. The second assumption follows from the fact that we are considering a pure hydrogen atmosphere.

However, for comparison, we present the more general formulae in the notation used by Menzel:

$$4\pi e_\nu = N_{ion} f(v) dv A_{ki} hR\nu \frac{dk}{d(R\nu)},$$

$$4\pi K_\nu = [N_i B_{ik} - N_{ion} f(v) dv B_{ki}] hR\nu \frac{dk}{d(R\nu)},$$

where $f(v) dv$ is the probability that an electron has a velocity $v \pm dv$;

$$A_{ki} = \frac{2hR^3 v^3}{c^2} \frac{\bar{\omega}_i}{\bar{\omega}_k} B_{ik},$$

$$B_{ki} = \frac{\bar{\omega}_i}{\bar{\omega}_k} B_{ik},$$

$$B_{ik} = \tilde{B}_{ik},$$

$$\bar{\omega}_k = \frac{4\pi (mv)^2 d(mv)}{h^3 N_e}.$$

If the velocity distribution is Maxwellian

$$f(v) dv = l^3 e^{-U_k} 4\pi (mv)^2 d(mv) \cdot h^{-3},$$

the above expressions reduce to Equations 39 and 40.

When a number of transitions contribute to the absorption and emission coefficients at the same frequency, the total absorption and emission coefficient is just the sum of the individual contributions.

Define x_ν as the absorption cross-section per neutral atom. Let N_o be the number of neutral atoms/cm³. Then, the continuous x_ν is the sum of the individual contributions, i.e.

$$x_\nu [\text{cm}^2] = \sum_{\nu_i < \nu} i \left(\frac{N_i}{N_o} \tilde{B}_{ik} - \frac{N_e^2}{N_o} l^3 e^{-U_k} \tilde{B}_{ki} \right) hR\nu \frac{dk}{d(R\nu)}. \quad (48)$$

To sufficient accuracy, we can set $N_o = N_1$ (the population of the ground state); in LTE N_i/N_1 and N_e^2/N_1 are given by the Boltzmann and the Boltzmann-Saha relation respectively, and are a function only of temperature. Since \tilde{B}_{ik} and \tilde{B}_{ki} are atomic constants and l and U_k are functions only of temperature, x_ν is a function only of temperature.

The contribution to the source function, from a continuous transition from a bound state i to a continuous state k , is

$$S_\nu = \frac{\epsilon_\nu}{K_\nu} = \frac{\frac{2hR^3 v^3}{c^2}}{\frac{N_i}{N_e^2} \frac{1}{l^3 e^{-U_k} \bar{\omega}_i / 2} - 1}. \quad (49)$$

The assumption of LTE is that the atomic populations are distributed according to the equilibrium formulae, i.e. that N_i/N_e^2 is given by the Boltzmann-Saha equation (Equation 47). Substituting for N_i/N_e^2 , we find that in LTE

$$S_\nu = \frac{\frac{2hR^3 \nu^3}{c^2}}{e^U - 1} = B_\nu . \quad (50)$$

The total source function is the ratio of the total emission to the total absorption coefficient. If we denote by the superscript (i) the contribution of the i^{th} transition, the total source function is

$$S_\nu = \frac{\sum_i \epsilon_\nu^{(i)}}{\sum_i K_\nu^{(i)}} = \frac{\sum_i K_\nu^{(i)} S_\nu^{(i)}}{\sum_i K_\nu^{(i)}} . \quad (51)$$

In LTE, $S_\nu^{(i)} = B_\nu$, and

$$S_\nu = \frac{\sum_i K_\nu^{(i)} B_\nu}{\sum_i K_\nu^{(i)}} = B_\nu . \quad (52)$$

Our derivation indicated that a *sufficient* condition for the validity of the Boltzmann and the Boltzmann-Saha equations is that the local radiation field be the Planck Function. Let me emphasize that although this is a sufficient condition, it is not also a *necessary condition*. The assumption of LTE asserts that the *atomic populations* are distributed according to the Boltzmann and Boltzmann-Saha equations. It asserts nothing explicitly about the local radiation field. Although it is not immediately obvious how these equations can also hold if the radiation field is not equilibrium radiation (i.e. given by the Planck Function), especially in the absence of collisional transitions, this possibility is not excluded.

We now return to the equations of transfer. Assuming LTE, both k_ν and S_ν are now specified by a single parameter, the temperature. Note that

$$K_\nu = N_o x_\nu(T) \quad (53)$$

and

$$K = N_o x(T) , \quad (54)$$

where x is a frequency weighted average of x_ν , so that $k_\nu = \frac{K_\nu}{K} = \frac{x_\nu}{x}$ is also a function only of temperature. It is convenient to define x from the asymptotic expansion of the monochromatic flux

(Equation 20). In LTE, $S_\nu = B_\nu$ and

$$F_\nu = \frac{4}{3} \frac{dB_\nu}{dT_\nu} = \frac{4}{3} \frac{dB_\nu}{dT} \frac{d\tau_\nu}{d\tau} \frac{dT}{d\tau} = \frac{4}{3} \frac{dB_\nu}{dT} \frac{x}{x_\nu} \frac{dT}{d\tau}. \quad (55)$$

Integrating over frequency

$$F = \frac{4}{3} \int_0^\infty \frac{dB_\nu}{dT} \cdot \frac{x}{x_\nu} \cdot d\nu \cdot \frac{dT}{d\tau}. \quad (56)$$

If we define

$$x^{-1} = \frac{\int_0^\infty \frac{dB_\nu}{dT} \frac{1}{x_\nu} d\nu}{\int_0^\infty \frac{dB_\nu}{dT} d\nu}, \quad (57)$$

$$F = \frac{4}{3} \int_0^\infty \frac{dB_\nu}{dT} d\nu \cdot \frac{dT}{d\tau} = \frac{4}{3} \frac{dB}{dT}. \quad (58)$$

Equation 57 defines the Rosseland mean and Equation 58 is the asymptotic form of the flux in the "Grey Atmosphere" (x_ν independent of frequency). Thus we expect that at large τ , the temperature in the non-grey atmosphere will have the same slope as in the grey atmosphere, when the Rosseland mean is used to define τ .

For the pure hydrogen atmosphere in radiative equilibrium, a complete solution of the radiative transfer problem consists in specifying T as a function of τ . Given $T(\tau)$, we can calculate $t_\nu(t)$ from

$$t_\nu(t) = \int_0^t k_\nu [T(t)] dt, \quad (59)$$

and $F(\tau)$ from

$$F(\tau) = 2 \int_0^\infty d\nu \left\{ \int_{t_\nu(\tau)}^\infty dt k_\nu [T(t)] B_\nu [T(t)] E_2 [t_\nu(t) - t_\nu(\tau)] \right. \\ \left. - \int_0^{t_\nu(\tau)} dt k_\nu [T(t)] B_\nu [T(t)] E_2 [t_\nu(\tau) - t_\nu(t)] \right\}. \quad (60)$$

The solution for the temperature distribution is that $T(\tau)$ which satisfies Equation 60 for $F = \text{constant}$. An iterative solution for $T(\tau)$ is developed in Chapter 3. With $T(\tau)$ known, the density distribution is obtained by integrating the equation of hydrostatic equilibrium.

We can then evaluate the steady state atomic populations. The condition for the atomic populations to be constant in time can be written

$$N_i \sum_j p_{ij} = \sum_j p_{ji} N_j , \quad (61)$$

where $p_{ij} [\text{sec}^{-1}]$ = number of transitions per sec from the i^{th} state to the j^{th} state. The continuum is treated as a single state having a Maxwellian velocity distribution and N_e^2 particles (N_e electrons and N_e protons). The assumption of a Maxwellian velocity distribution for the continuum can be justified as follows. First, we show that the mean free path for electron-electron or electron-ion collisions is much smaller than the mean free path for a photon. Thus we can assume that the temperature gradient over an electron-electron mean free path is small. We then show that electron-electron collisions are more frequent than photo-ionizations. Thus, between photo-ionizations, the electron suffers many encounters with other electrons, and since the electrons see an almost constant kinetic temperature, the electron velocity distribution tends toward an equilibrium distribution. The electron-electron mean free path Λ_{e-e} is

$$\Lambda_{e-e} = \frac{1}{N_e \sigma_{e-e}} ; \quad (62)$$

$$\sigma_{e-e} = \pi D^2 = \pi \cdot \frac{kT}{4\pi e^2 N_e} \approx 10^2 \frac{T}{N_e} , \quad (63)$$

where D is the Debye length. $T = 10^4 \text{ }^\circ\text{K}$ is a good average value for an AO star photosphere so $\Lambda_{e-e} \approx 10^{-6} \text{ cm}$. On the other hand, the photon mean free path $\Lambda_{\gamma-H}$ is

$$\Lambda_{\gamma-H} = \frac{1}{N_o \sigma_{\gamma-H}} . \quad (64)$$

The Planck mean of $\sigma_{\gamma-H} < 10^{-18} \text{ cm}^2$, so $\Lambda_{\gamma-H} > 10^{18} N_o^{-1} \text{ cm}$. Since $N_o < 10^{15}$ in an AO photosphere, $\Lambda_{e-e}/\Lambda_{\gamma-H} < 10^{-7}$.

The number of photo-ionizations per sec per ejected electron is

$$r_e = N_\gamma c \sigma_{\gamma-H} , \quad (65)$$

where $N_\gamma = 16\pi \left(\frac{kT}{hc} \right)^3$ is the photon density and c is the speed of light. Inserting numerical values, $r_e \approx 10^{-6} T^3$. The number of electron-electron collisions per sec per electron c_e



is

$$c_e = N_e \bar{v} \sigma_{e+e} \quad (66)$$

where

$$\bar{v} = c \left(\frac{8kT}{\pi m c^2} \right)^{1/2}.$$

Inserting numerical values, $c_e \approx 10^2 T^{3/2}$ whence for

$$T \approx 10^4 \text{ K}, \quad \frac{c_e}{r_e} \approx 10^2.$$

Chapter 3

AN AO STAR MODEL ATMOSPHERE

The assumption of LTE and a chemical composition of pure hydrogen allow the equation of transfer to be decoupled from the equation of hydrostatic equilibrium and the source function and absorption coefficient to be completely specified by a single parameter, the temperature. Thus, the radiative transfer problem is determined separately by specifying the net flux, πF . It is customary to specify the net flux by an effective temperature T_{eff} , defined by $\pi F = \sigma T_{\text{eff}}^4$. We choose $T_{\text{eff}} = 10^4 \text{ K}$ as typical of an AO star. The formulae for the absorption coefficient and the source functions have been given in the previous chapter. What remains is to solve for the temperature distribution $T(\tau)$, satisfying radiative equilibrium. An iterative solution for $T(\tau)$ is first developed for the grey atmosphere and then applied to the frequency-dependent atmosphere. Finally, the equation of hydrostatic equilibrium is integrated to provide the density distribution.

ITERATIVE SOLUTION FOR THE TEMPERATURE DISTRIBUTION IN THE GREY ATMOSPHERE

Before attempting a solution for the temperature distribution in the frequency-dependent atmosphere, it is worthwhile investigating the simpler problem presented by the grey atmosphere. The grey atmosphere is attractive because there is an existence theorem guaranteeing its solution, and an accurate solution is already available. Also, in the grey atmosphere, many results are obtainable analytically so that we can survey our methods in some generality. Finally, asymptotically, (that is to say with increasing depth) the grey results are applicable to the non-grey atmosphere.

By neglecting the frequency dependence of the absorption coefficient, we obtain the equation of transfer for the grey atmosphere

$$\mu \frac{\partial I(\tau, \mu)}{\partial \tau} = I(\tau, \mu) - B[T(\tau)] \quad (67)$$

where

$$\pi B(T) = \pi \int_0^\infty B_\nu(T) d\nu = \sigma T^4 .$$



We base our iterative procedure on a linear approximation to $B(\tau)$. From the expansions developed in the last section, we have that asymptotically ($\tau \rightarrow \infty$)

$$F = \frac{4}{3} \frac{dB}{d\tau} . \quad (68)$$

Hence, since $F = \text{constant}$,

$$B(\tau) = \frac{3}{4} F \tau + B(0) , \quad (69)$$

and the constant is determined by requiring the approximation to yield the correct flux at the origin:

$$\begin{aligned} F(0) &= \int_0^\infty B(t) E_2(t) dt = \frac{1}{2} F + B(0) \\ \therefore B(0) &= \frac{1}{2} F ; \\ B(\tau) &= \frac{1}{2} F \left(1 + \frac{3}{2} \tau \right) . \end{aligned} \quad (70)$$

This approximation, first derived by Eddington, produces a maximum error of the flux of 2.6 percent at $\tau = 0.4$. The maximum of $|df/d\tau|$ is $\frac{1}{4}F$ and occurs at the origin.

To obtain a more accurate result, we guess a trial solution of the equation of transfer $B^{(\circ)}(\tau)$ and expand:

$$B(\tau) = B^{(\circ)}(\tau) + \delta B(\tau) ,$$

$$I(\tau, \mu) = I^{(\circ)}(\tau, \mu) + \delta I(\tau, \mu) ,$$

$$F = F^{(\circ)}(\tau) + \delta F(\tau) .$$

At large τ , $F \approx \frac{4}{3} \frac{dB}{d\tau}$ so

$$\delta F(\tau) \approx \frac{4}{3} \frac{d}{d\tau} \delta B(\tau) , \quad (71)$$

whence

$$\delta B(\tau) = \frac{3}{4} \int_0^\tau \delta F(t) dt + \delta B(0) . \quad (72)$$

Using the linear solution [Equation 70 wherein $B(0) = \frac{1}{2}F$] to obtain an estimate for $\delta B(0)$, we set

$$\delta B(0) = \frac{1}{2} \delta F(0) , \quad (73)$$

whence

$$\delta B(\tau) = \frac{3}{4} \int_0^\tau \delta F(t) dt + \frac{1}{2} \delta F(0) . \quad (74)$$

On the other hand, the equation of radiative equilibrium

$$\frac{1}{4} \frac{dF}{d\tau} = J - B , \quad (75)$$

can also be used to obtain a correction to the temperature, which is of the form

$$\delta B(\tau) = \frac{1}{4} \frac{d}{d\tau} \delta F(\tau) . \quad (76)$$

Since at large τ , $J \rightarrow B$, we do not expect this term to make any contribution in this range. Thus it seems permissible to add Equations 74 and 76 to obtain the total correction to $B(\tau)$. Noting that $F = F - F^{(o)}$, requiring F to be the prescribed flux, and dividing both sides of the equation by F , we obtain for the correction to $B(\tau)$:

$$\frac{\delta B(\tau)}{F} = \frac{3}{4} \int_0^\tau \left[1 - \frac{F^{(o)}(t)}{F} \right] dt + \frac{1}{2} \left[1 - \frac{F^{(o)}(0)}{F} \right] + \frac{1}{4} \frac{1}{F} \frac{dF^{(o)}(\tau)}{d\tau} . \quad (77)$$

It is convenient to normalize the individual terms in Equation 77. We also attach a superscript (o) to δB to indicate that it derives from $B^{(o)}$. Let:

$$f^{(o)}(\tau) = \frac{F^{(o)}(\tau)}{F} ,$$

$$b^{(o)}(\tau) = \frac{B^{(o)}(\tau)}{F} ,$$

$$j^{(o)}(\tau) = \frac{J^{(o)}(\tau)}{F} ,$$

$$\delta b^{(o)}(\tau) = \frac{\delta B^{(o)}(\tau)}{F} .$$



Then:

$$\delta b^{(o)}(\tau) = \frac{3}{4} \int_0^\tau [1 - f^{(o)}(t)] dt + \frac{1}{2} [1 - f^{(o)}(0)] + \frac{1}{4} \frac{df^{(o)}(\tau)}{d\tau}. \quad (78)$$

This correction procedure was first derived by Unsöld (Reference 4). We note that if we take as our initial guess $b^{(o)}(\tau) = 0$ then

$$f^{(o)}(\tau) = \frac{df^{(o)}(\tau)}{d\tau} = 0 \quad \text{and} \quad \delta b^{(o)}(\tau) = \frac{3}{4} \tau + \frac{1}{2},$$

so that our next guess $b^{(1)}(\tau) = b^{(o)}(\tau) + \delta b^{(o)}(\tau)$ is just the Eddington solution.

Before applying Equation 78 to a numerical example, it is worth investigating the corrective power of this iterative method in a few simple cases. First suppose that $b^{(o)}(\tau) = b(\tau) - \mathfrak{C}_0$ where \mathfrak{C}_0 is a constant, and $b(\tau)$ is the correct solution. Then

$$f^{(o)}(\tau) = 1 - 2 \mathfrak{C}_0 E_3(\tau),$$

$$1 - f^{(o)}(\tau) = 2 \mathfrak{C}_0 E_3(\tau),$$

$$\frac{3}{4} \int_0^\tau [1 - f^{(o)}(t)] dt = \frac{1}{2} \mathfrak{C}_0 [1 - 3 E_4(\tau)],$$

$$\frac{1}{2} [1 - f^{(o)}(0)] = \frac{1}{2} \mathfrak{C}_0,$$

$$\frac{1}{4} \frac{df^{(o)}(\tau)}{d\tau} = j^{(o)}(\tau) - b^{(o)}(\tau) = \frac{1}{2} \mathfrak{C}_0 E_2(\tau),$$

$$b^{(1)}(\tau) = b(\tau) + \frac{1}{2} \mathfrak{C}_0 [E_2(\tau) - 3 E_4(\tau)].$$

We note that

$$b^{(1)}(0) = b(0),$$

$$b^{(1)}(\tau) \rightarrow b(\tau) \text{ as } \tau \rightarrow \infty.$$

The maximum error occurs at $\tau \approx 0.4$ and is $\frac{1}{2} \mathfrak{C}_0 [0.18]$.

Table 1 shows the corrections for initial guesses that differ from the correct solution by a constant, by a term linear in τ and by a term quadratic in τ . We note that the errors at large τ

Table 1
 Corrections to Initial Guesses $[b^{(0)}]$ of the Source Function in the Grey Atmosphere.

$b^{(0)}(\tau) \rightarrow$	$b - \mathfrak{A}_0$	$b - \mathfrak{A}_1 \tau$	$b - \mathfrak{A}_2 \tau^2$
$\frac{3}{4} \int_0^\tau [1 - f^{(0)}(t)] dt$	$\frac{1}{2} \mathfrak{A}_0 [1 - 3 E_4(\tau)]$	$\mathfrak{A}_1 \left[\tau - \frac{3}{8} + \frac{3}{2} E_5(\tau) \right]$	$\mathfrak{A}_2 \left[\tau^2 + \frac{3}{5} - 3 E_6(\tau) \right]$
$\frac{1}{2} [1 - f^{(0)}(0)]$	$\frac{1}{2} \mathfrak{A}_0$	$\frac{1}{3} \mathfrak{A}_1$	$\frac{1}{2} \mathfrak{A}_2$
$\frac{1}{4} \frac{df^{(0)}(\tau)}{d\tau}$	$\frac{1}{2} \mathfrak{A}_0 E_2(\tau)$	$-\frac{1}{2} \mathfrak{A}_1 E_3(\tau)$	$-\frac{2}{3} \mathfrak{A}_2 \left[1 - \frac{3}{2} E_4(\tau) \right]$
$b^{(1)}(\tau) - b(\tau)$	$\frac{1}{2} \mathfrak{A}_0 [E_2(\tau) - 3 E_4(\tau)]$	$\frac{1}{2} \mathfrak{A}_1 \left[-\frac{1}{12} - E_3(\tau) + 3 E_5(\tau) \right]$	$\mathfrak{A}_2 \left[\frac{13}{30} + E_4(\tau) - 3 E_6(\tau) \right]$

are efficiently removed by the correction term involving the integral over the error in the flux. (An error proportional to τ^3 would not be completely removed, but would be reduced by two powers of τ .) The term involving the derivative of the flux, while effective near the origin, makes no correction at large τ , owing to the fact that at large τ , $j \rightarrow b$ independent of the distribution of b with τ .

Numerical accuracy of the iteration procedure depends on the accuracy of the integrations, which in turn depends on the number of integration points and their spacing. We present three cases. For the first two, $b^{(0)}(\tau) = 0$ so that $b^{(1)}(\tau) = \frac{1}{2} + \frac{3}{4} \tau$. In the third case $b^{(0)}(\tau) = 100 - 2 \tau$ so that $b^{(0)}(0) = 100$ and $b^{(0)}(100) = -100$.

Cases 1, 3

$$\tau_0 = 0$$

$$\tau_1 = 10^{-5}$$

$$\tau_{n+1} = 10^{-5+0.1n} \quad n \geq 1$$

$$\tau_{N+1} = 100 \quad (\text{last point})$$

$$N = 70 .$$

Case 2

$$\tau_0 = 0$$

$$\tau_1 = 10^{-5}$$

$$\tau_{n+1} = 10^{-5 + 0.025n} \quad n \geq 1$$

$$\tau_{N+1} = 100 \quad (\text{last point})$$

$$N = 280 .$$

We illustrate the rate of convergence by plotting $\log |1 - f^{(n)}(\tau)|$ as a function of $\log \tau$ and the number n (of iterations carried out) (Figures 1-3). For the second case, which has a maximum of error in the flux of 8 parts in a million (after the seventh iteration) we present the final results in Appendix B.

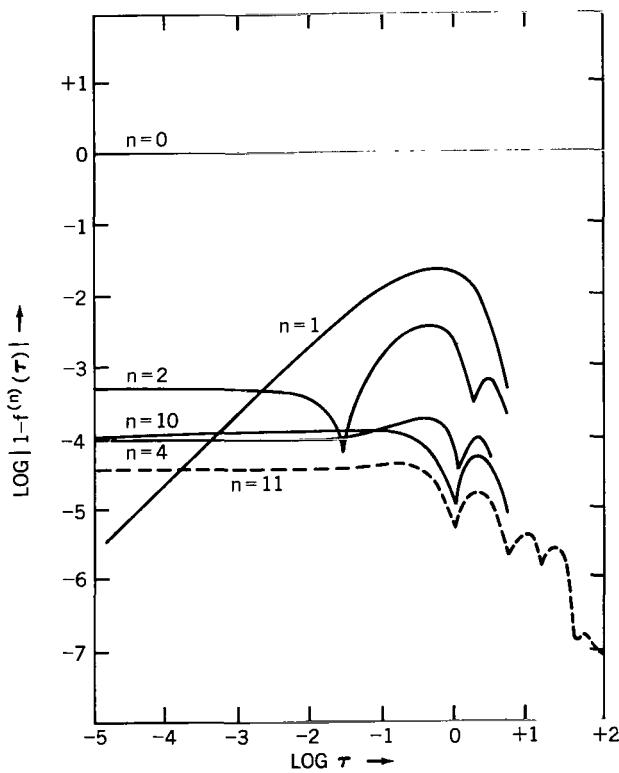


Figure 1—Relative error in the flux for the grey atmosphere as a function of the number of iterations, 70 points in τ , $b^{(o)}(\tau) = 0$ (for $n = 11$, the number of τ points were doubled).

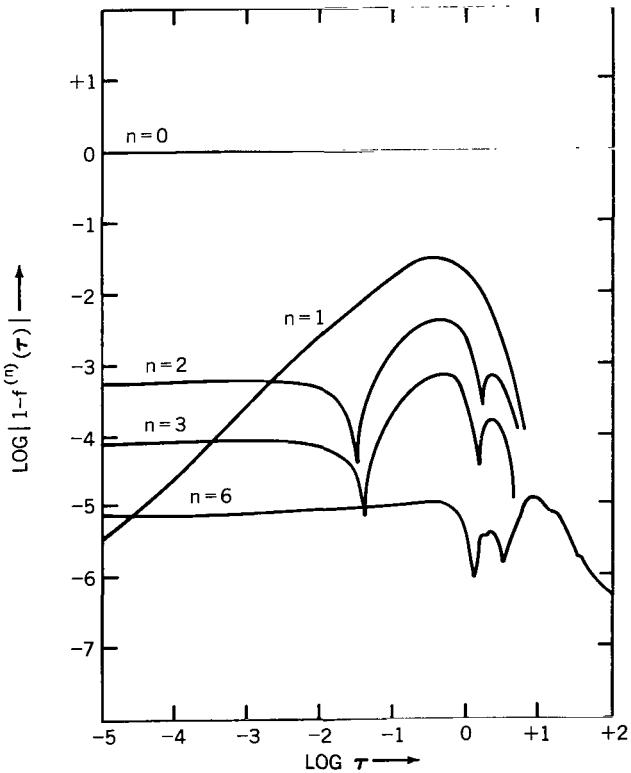


Figure 2—Relative error in the flux for the grey atmosphere as a function of the number of iterations, 280 points in τ , $b^{(o)}(\tau) = 0$.

The ripples in the error curve were first thought to be a function of the point spacing, but they were found to appear also when the points were equally spaced in τ . They are now surmised to be introduced by the iteration procedure.

The iterations were terminated when the scheme ceased to make corrections, i.e. when $|\delta b^{(n)}(\tau)|_{\max} < 10^{-6}$.

This does not mean that the flux is correct to this accuracy. For 70 τ -points, when iterations were terminated, the error in the flux was about 10^{-4} , while for 280 τ -points, the error in the flux was about 10^{-5} . The iteration procedure converges to the solution of the *finite difference* problem defined by the given τ -point distribution. It solves this finite difference problem to a high accuracy, but the resulting solution is only an approximation to the continuous solution. As a further test, for the 70 τ -point case, the number of τ -points were doubled after the program had stopped iterating. Resuming the iteration procedure, the corrections again exceeded the 10^{-6} limit and the error in the flux was reduced by half an order of magnitude. The conclusion is that the error in matching the boundary conditions is *not* given by the difference between two successive iterations.

One can also check the expansion for the flux (Equations 17 and 19). The derivatives of b were obtained from the final iteration. The results are presented in Tables 2 and 3. Right near the origin, the expansions diverge, but for $\tau = 0.5$, the asymptotic expansions are already quite adequate.

Finally, a grey atmosphere was integrated monochromatically in order to check the frequency at which the flux was a maximum. Expressed in dimensionless form this result is presented in Figure 4. We see that the frequency at which the flux is a maximum is bounded below by the frequency at which the Planck function is a maximum and bounded above by the frequency at which the temperature derivative of the Planck function is a maximum. After $\tau = 1$ it approaches the latter frequency rapidly.

To summarize this section, we have developed an iterative procedure designed to calculate the temperature distribution in a grey atmosphere in radiative equilibrium. This procedure turns out to be insensitive to the initial guess and converges rapidly, reducing the error in a flux by approximately one order of magnitude on each iteration.

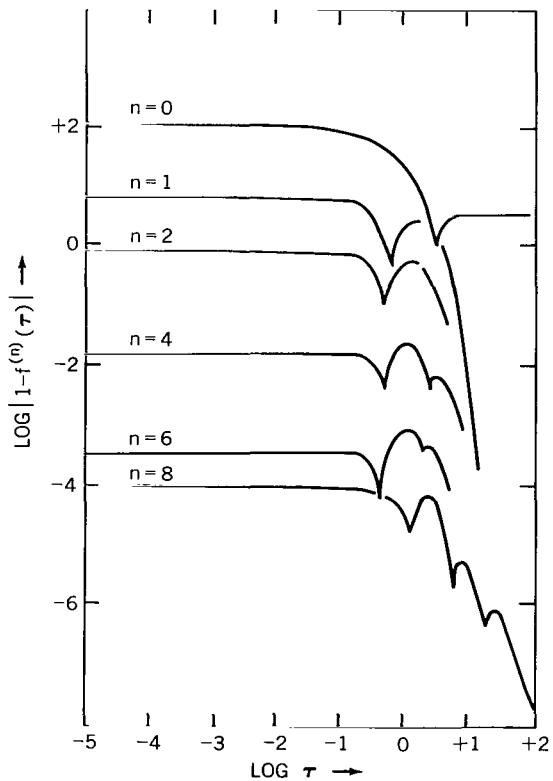


Figure 3—Relative error in the flux for the grey atmosphere as a function of the number of iterations, 70 points in τ , $b^{(0)}(\tau) = 100 - 2\tau$.

Table 2

Derivatives of $b(\tau)$ in the Grey Atmosphere.

τ	b	b'	b''	b'''
0.05	0.49557	1.0681	-3.283	+79.3
0.1	0.54594	0.9623	-1.391	+16.9
0.5	0.88522	0.7969	-0.126	+0.4
1.0	1.27391	0.7652	-0.030	0
1.5	1.65386	0.7561	-0.009	
2.0	2.03095	0.7527	-0.004	
2.5	2.40691	0.7513	0	
3.0	2.78238	0.7506		
4.0	3.53273	0.7502		
5.0	4.28282	0.7501		

Table 3

Expansions for the Flux in the Grey Atmosphere.

τ	$b + \frac{2}{3}b'$	$\frac{4}{3}b'$
0.05	1.203	1.424
0.1	1.188	1.283
0.5	1.416	1.063
1.0		1.020
1.5		1.008
2.0		1.004
2.5		1.002
3.0		1.001
4.0		1.000
5.0		1.000

From the accurate temperature distribution, we found that the asymptotic expansions for the flux are in error by only 6 percent at $\tau = 0.5$ and quickly improve at large τ . The expansions about the origin diverge (because at the origin the derivative of the temperature is divergent), but if the second and higher derivatives are arbitrarily neglected, the remainder of the expansion gives reasonable results.

ITERATIVE SOLUTION FOR THE TEMPERATURE DISTRIBUTION IN THE FREQUENCY-DEPENDENT ATMOSPHERE

We now extend the results of the previous section to the frequency-dependent atmosphere. Because the situation here is vastly more complicated than in the grey case, we will appeal at times to the final results to justify certain approximations.

The equation of transfer for the frequency-dependent atmosphere is

$$\mu \frac{\partial I_\nu(\tau, \mu)}{\partial \tau} = \frac{x_\nu[T(\tau)]}{x[T(\tau)]} \left\{ I_\nu(\tau, \mu) - B_\nu[T(\tau)] \right\}. \quad (79)$$

The frequency-dependent equations, analogous to the grey equations which formed the basis of the previous iteration scheme, (Equations 68 and 75) are

$$F_\nu(\tau) = \frac{4}{3} \frac{dB_\nu}{dT_\nu} = \frac{4}{3} \frac{dB_\nu}{dT} \frac{x}{x_\nu} \frac{dT}{d\tau} \quad (80)$$

and

$$\frac{\partial F_\nu(\tau)}{\partial \tau} = \frac{x_\nu}{x} [J_\nu(\tau) - B_\nu(\tau)]. \quad (81)$$

A new feature is the appearance of $\frac{x_\nu}{x}$, which could now also be perturbed. We choose to neglect this perturbation on the grounds that in the frequency range where the flux is a maximum, this ratio is close to unity anyway.

The grey analog to Equation 80 led to a correction term involving an integral over the error in the flux. This term removed errors in the temperature distribution at large τ but made only slight contributions near the origin. In Figure 5 we compare Equation 80 with the actual monochromatic net flux and illustrate that it is a good approximation at even moderately large τ . Integrating this equation over

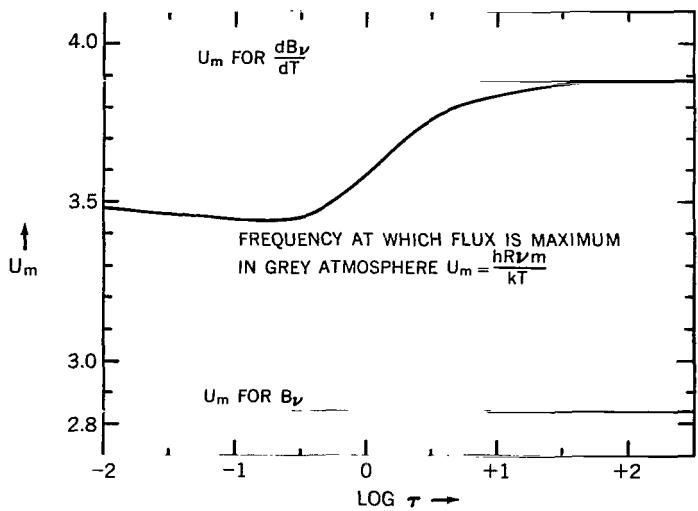


Figure 4—Frequency at which the flux is a maximum in the grey atmosphere.

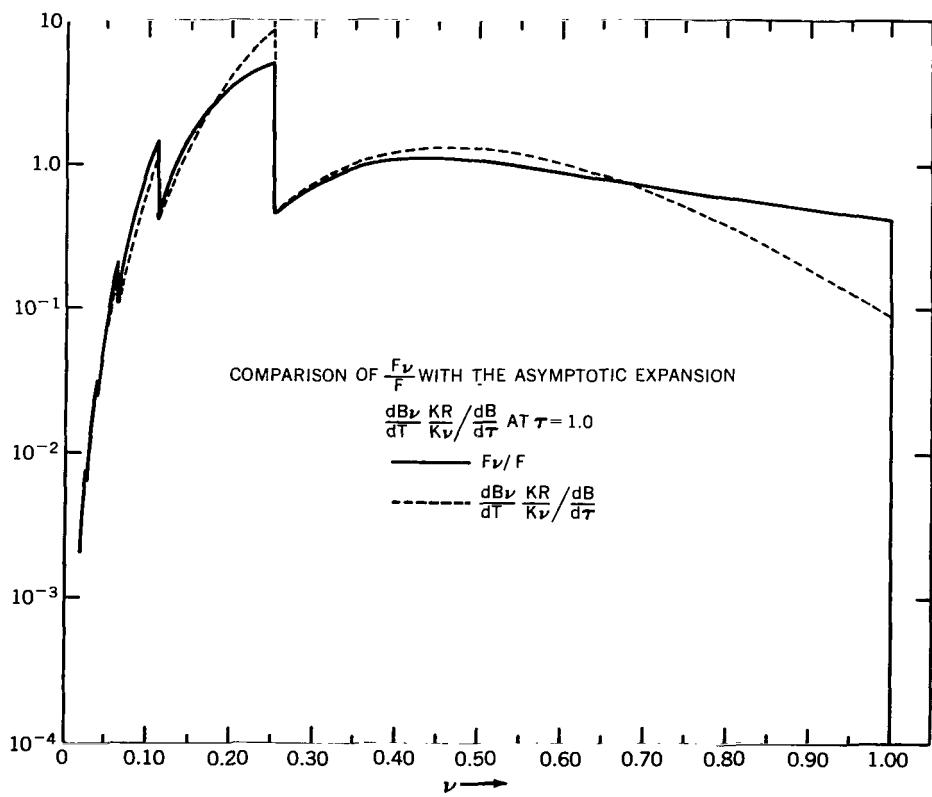


Figure 5—Comparison of F_ν/F with the asymptotic expansion $\frac{dB}{dT} \frac{KR}{K_\nu} / \frac{d\bar{B}}{d\tau}$ at $\tau = 1.0$.

frequency we obtain

$$F = \frac{4}{3} \frac{dB}{d\tau} . \quad (82)$$

This approximation is compared to the actual flux in Figure 6. As in the grey case, the correction term derived from Equation 82 is

$$\delta b^{(o)}(\tau) = \frac{3}{4} \int_0^\tau [1 - f^{(o)}(t)] dt + \frac{1}{2} [1 - f^{(o)}(0)] . \quad (83)$$

Equation 83 is expanded under the integrand as in the grey case

$$\frac{\partial F}{\partial \tau} = 0 = \int_0^\infty d\nu \frac{x_\nu}{x} (J_\nu - B_\nu) \approx \int_0^\infty d\nu \frac{x_\nu}{x} (J_\nu^{(o)} - B_\nu^{(o)} - \delta B_\nu^{(o)}) .$$

Writing

$$\delta B_\nu^{(o)} = \frac{\frac{dB_\nu^{(o)}}{dT}}{\delta T^{(o)}} \delta T^{(o)} = \frac{\frac{dB_\nu^{(o)}}{dT}}{\frac{dB^{(o)}}{dT}} \delta B^{(o)}$$

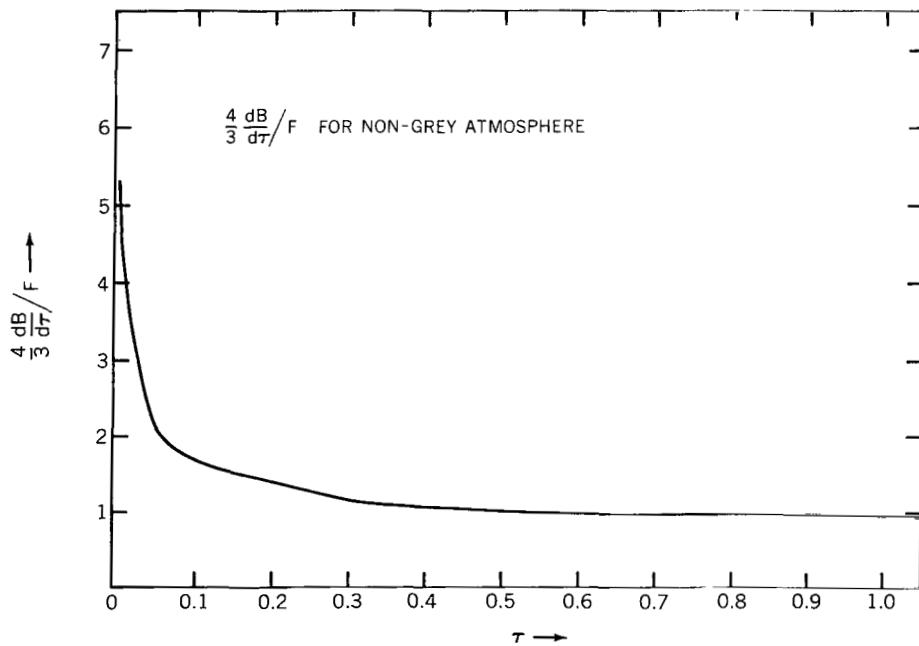


Figure 6— $\frac{4}{3} \frac{dB}{d\tau} / F$ for the non-grey atmosphere.

and defining

$$x_G = \int_0^\infty d\nu x_\nu \frac{\frac{dB_\nu}{dT}}{\frac{dB}{dT}}$$

the correction term becomes

$$\delta b^{(o)}(\tau) = \frac{1}{4} \frac{x}{x_G} \frac{\partial f^{(o)}(\tau)}{\partial \tau}. \quad (84)$$

This term differs from the corresponding term in the grey case by the factor $\frac{x}{x_G}$. For a wide range in temperatures, this ratio is very nearly constant and equal to about 10^{-2} . However, in practice, it was found that convergence could be made more rapid if this factor $\frac{x}{x_G}$ were set equal to about $1/2$, but only if, in addition, the absolute magnitude of $\frac{\partial f^{(o)}(\tau)}{\partial \tau}$ was restricted to less than unity.

The correction used in the numerical work is

$$\delta b^{(o)}(\tau) = \frac{3}{4} \int_0^\tau [1 - f^{(o)}(t)] dt + \frac{1}{2} [1 - f^{(o)}(0)] + \frac{1}{5} \frac{\partial f^{(o)}(\tau)}{\partial \tau} \quad (85)$$

where

$$\left| \frac{\partial f^{(o)}(\tau)}{\partial \tau} \right| \leq 1.$$

The correction to the temperature is

$$\delta T^{(o)}(\tau) = \frac{T_{eff.}^4}{4 T^{(o)}(\tau)^3} \delta b^{(o)}(\tau). \quad (86)$$

The rate of convergence is illustrated in Figure 7. It is difficult to attach an iteration number to the final result labeled $T_{non-grey}$ because that result was obtained by varying the number of τ -points on successive iterations. However, the first ($n = 0$) and the next three iterations used the same set of 68 τ -points.

On the following pages, various results are abstracted from the final non-grey iteration. In the appendix, the numerical results $t_\nu(\tau)$, $B_\nu(\tau)$,

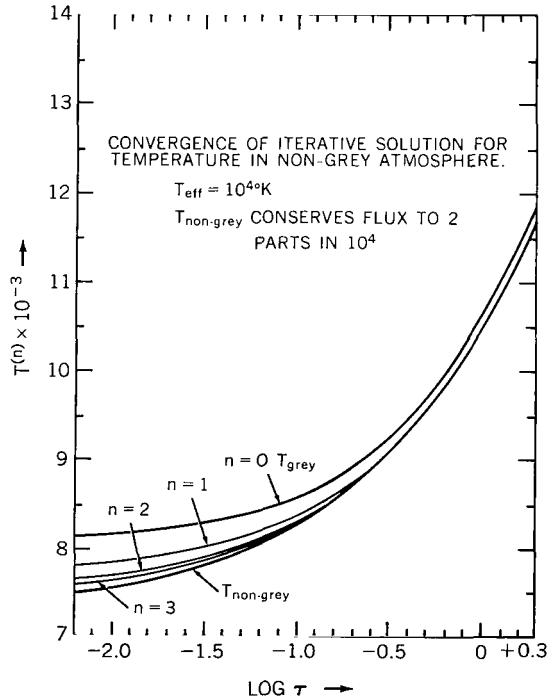


Figure 7—Convergence of the iterative solution for the temperature in the non-grey atmosphere.

$J_\nu(\tau)$, $F_\nu(\tau)$ are presented. Comparing the non-grey and grey temperature distributions (Figure 8) we note that the non-grey temperature is depressed below the grey one by about 9 percent at the origin, but rapidly approaches the grey temperature at $\tau \geq 1$. At $\tau = 1$, the slopes of the non-grey and grey temperatures are almost identical, indicating again the validity of the Rosseland approximation.

The relative errors in the flux and its derivative are plotted as a function of τ in Figures 9 and 10. Note the fluctuations at large τ . This is in part due to the sparse point spacing in this region, but also is caused by the correction routine. In contrast with the grey case, the errors increase at large τ . The explanation of this result is not certain. It may be in part due to the fact that the integral of the error in the flux starts at the origin, where the Rosseland approximation is not valid. Further investigation of the iterative routines is certainly warranted. However, the present results are more than accurate for our purposes, especially as we are mainly interested in the radiation field at very small τ .

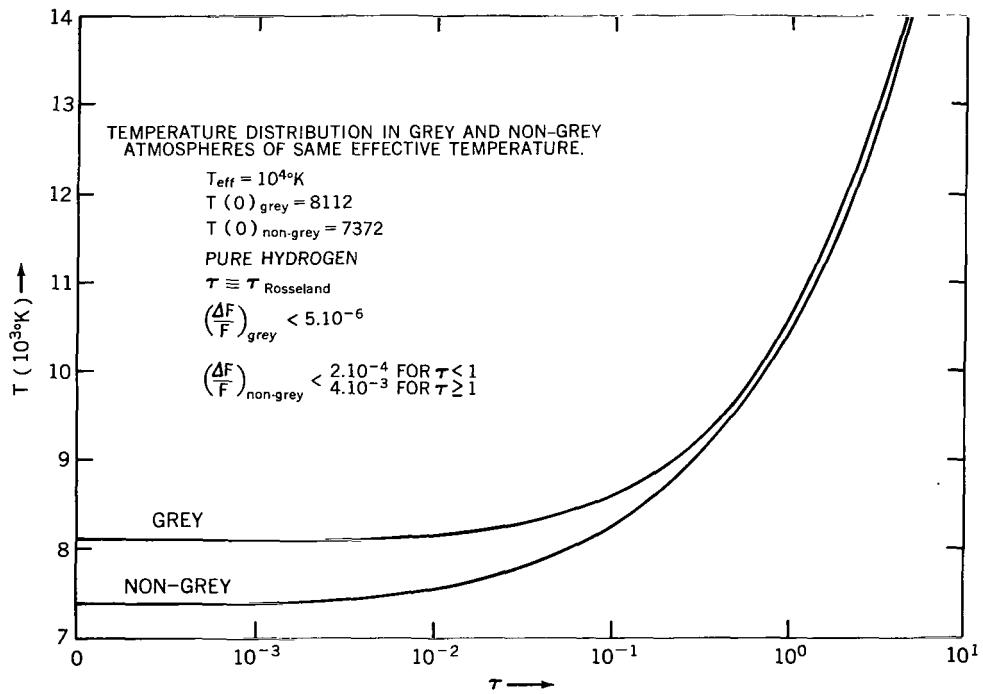


Figure 8—Temperature distribution in grey and non-grey atmosphere of the same effective temperature.

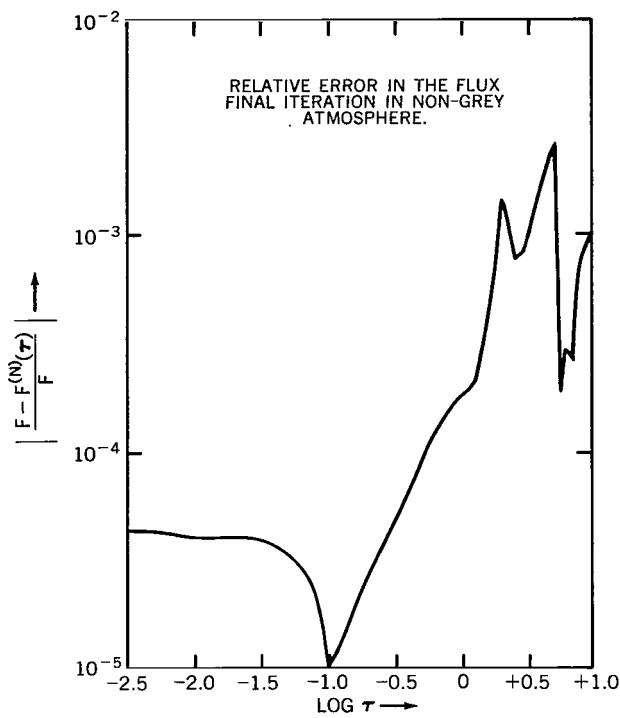


Figure 9—Relative error in the flux for the final iteration in the non-grey atmosphere.

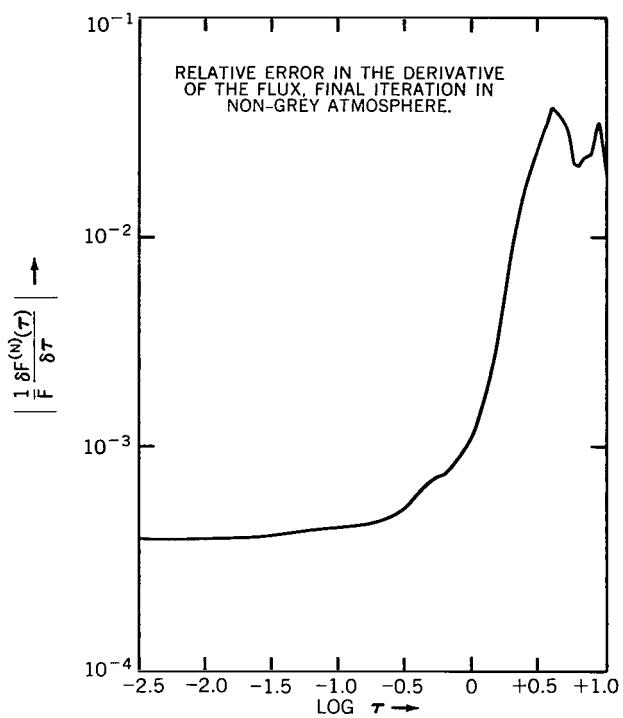


Figure 10—Relative error in the derivative of the flux for the final iteration in the non-grey atmosphere.

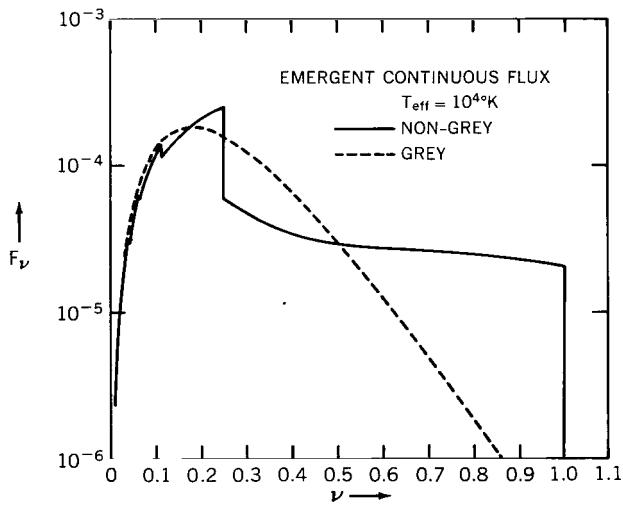


Figure 11—Emergent continuous flux in the non-grey atmosphere.

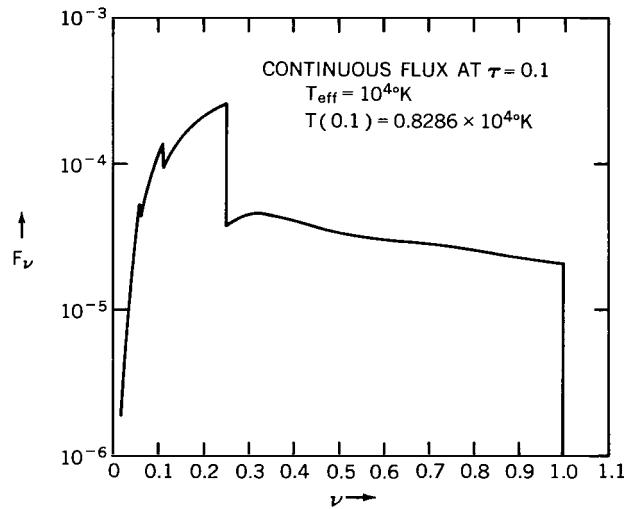


Figure 12—Continuous flux at $\tau = 0.1$ in the non-grey atmosphere.

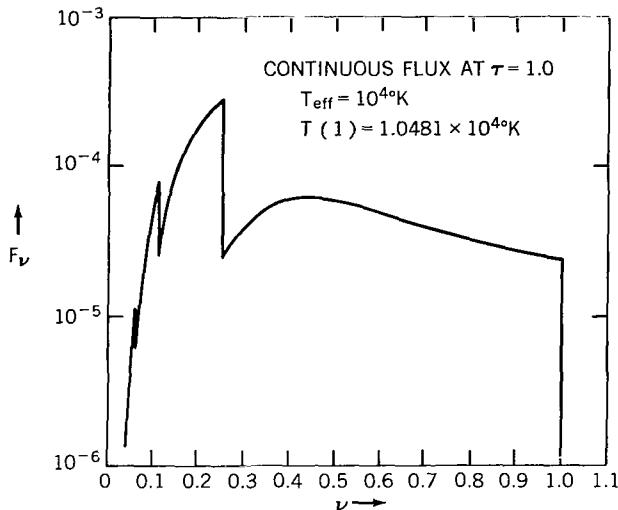


Figure 13—Continuous flux at $\tau = 1.0$ in the non-grey atmosphere.

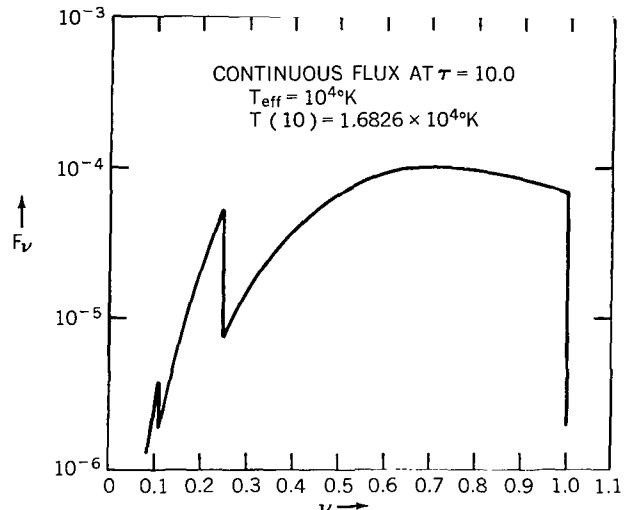


Figure 14—Continuous flux at $\tau = 10.0$ in the non-grey atmosphere.

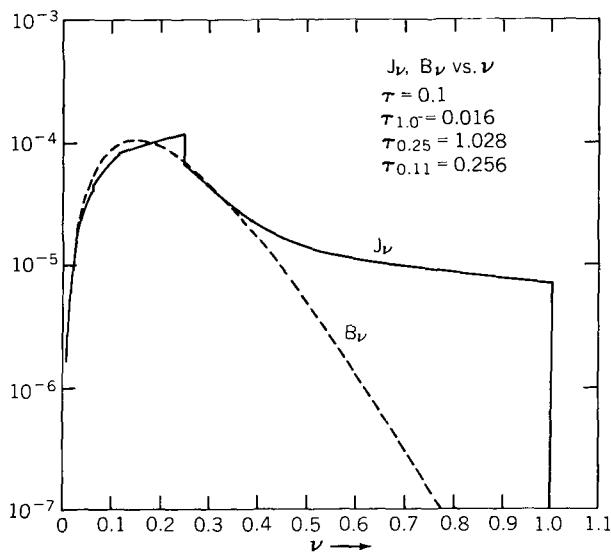


Figure 15— J_ν, B_ν vs. ν at $\tau = 0.1$.

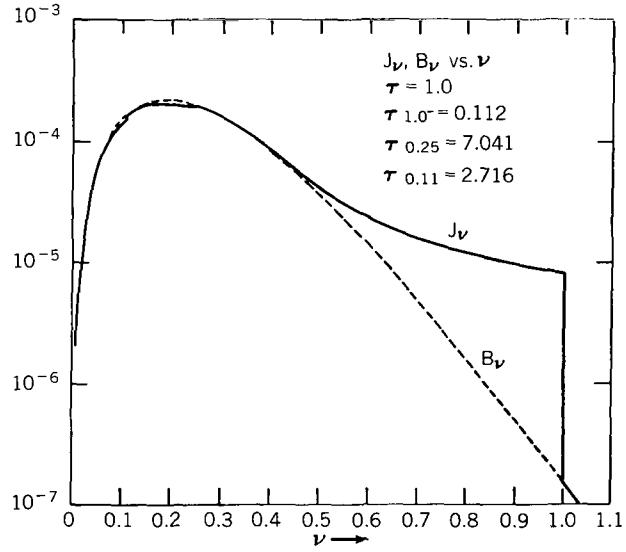


Figure 16— J_ν, B_ν vs. ν at $\tau = 1.0$.

THE EQUATION OF HYDROSTATIC EQUILIBRIUM

To complete the construction of the non-grey atmosphere, the equation of hydrostatic equilibrium is integrated to provide the pressure and density distributions.

The equation of hydrostatic equilibrium is

$$-\frac{dp}{dz} \approx g \rho , \quad (87)$$

and on introducing

$$d\tau = - K(p, T) dZ = - N_o(p, T) \alpha(T) dZ , \quad (88)$$

becomes

$$\frac{dp}{d\tau} = g \frac{N}{N_o} \frac{m_H}{x} , \quad (89)$$

where $\rho = N m_H \cdot m_H = \text{mass of hydrogen atom} = 1.673 \times 10^{-24} \text{ gm.}$

The equation of state for partially ionized hydrogen is

$$p = N [1 + \alpha(p, T)] kT \quad (90)$$

where

$$\alpha = \frac{Ne}{N} , \quad 0 \leq \alpha \leq 1 ,$$

$N = \text{number density of nuclei.}$

We also have

$$N = N_o + N_e \quad (91)$$

and

$$\frac{N_o}{N_e^2} = l^3 e^{U_H} , \quad (92)$$

where Equation 92 is obtained from the Boltzmann-Saha equation (Equation 47) by setting $N_o = N_1$, $U_1 = U_H$.

Combining Equations 90, 91, and 92, we obtain

$$\frac{1 - \alpha}{\alpha^2} = l^3 e^{U_H} \frac{p}{kT} . \quad (93)$$

Solving for α ,

$$\alpha = [1 + \phi(T) p]^{-1/2} , \quad (94)$$

where

$$\phi(T) = \frac{l^3 e^{U_H}}{kT} .$$

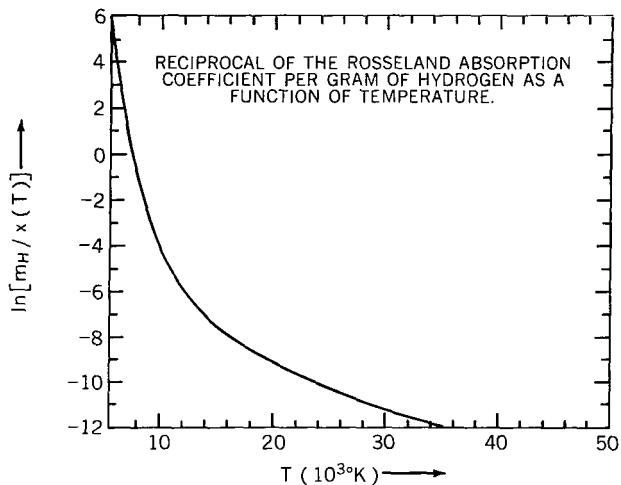


Figure 17—Log of the reciprocal of the Rosseland mean absorption coefficient per gram of hydrogen as a function of temperature.

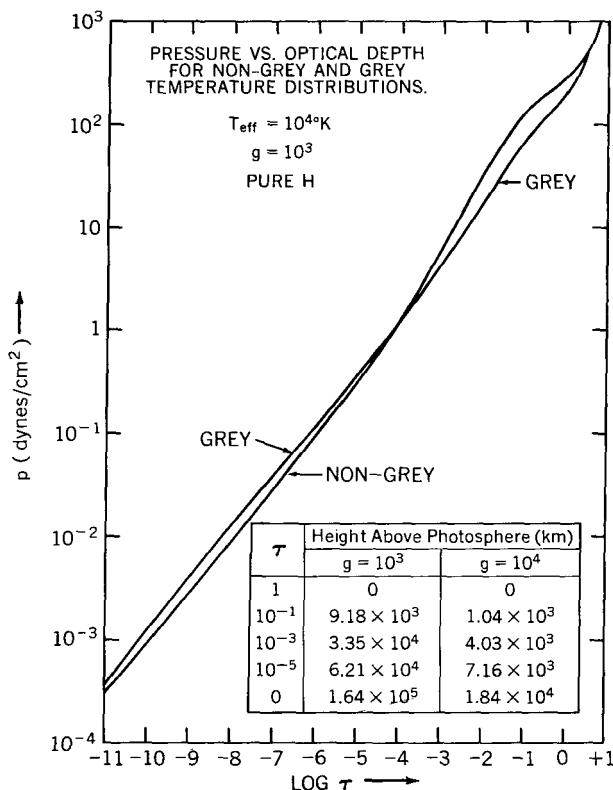


Figure 18—Pressure vs. optical depth for the non-grey and grey temperature distributions.

Letting

$$a(T) = \frac{m_H}{x(T)} \quad (95)$$

and noting that

$$\frac{N}{N_0} = \frac{1}{1 - a(p, T)}, \quad (96)$$

Equation 89 can be written

$$\frac{dp}{d\tau} = g \frac{a(T)}{1 - a(p, T)}; \quad (97)$$

$a(T)$ is displayed in Figure 17.

Since $T(\tau)$ is known, Equation 97 can be integrated numerically, with the boundary condition $p = 0$ at $\tau = 0$.

To start the integration at $\tau = 0$, note that when $p \approx 0$

$$a(p, T) \approx 1 - \frac{1}{2} \phi(T) p \quad (98)$$

and

$$\frac{dp^2}{d\tau} = 4g \frac{a(T)}{\phi(T)}. \quad (99)$$

The pressure as a function of optical depth for the non-grey and grey temperature distributions is displayed in Figure 18.

Chapter 4

STEADY STATE ATOMIC POPULATIONS

At this point in the calculation, we have available the radiation fields, total particle density, and temperature as a function of optical depth. At any depth in the atmosphere, we can compute the number of transitions per second. If the LTE approximation is adequate, the transition rates should be such that the populations of the atomic states are constant with time and distributed according to the Boltzmann Law.

In order that the populations be constant with time, the number of atoms leaving any state i to all other states, must be equal to the number of atoms entering state i from all other states. This is less restrictive than the condition of detailed balancing (the condition that prevails in thermodynamic equilibrium) which requires that the number of atoms leaving any state i to any particular state j by each process be balanced by atoms entering state i from state j by the inverse process.

Let

N_i = number of atoms per cm^3 in state i

p_{ij} = number of transitions per second from state i to state j

so that the number of atoms per cm^3 per sec leaving state i for state j is $N_i p_{ij}$. p_{ij} includes both radiative and collisional transitions.

Then

$$\frac{dN_i}{dt} = -N_i \sum_j' p_{ij} + \sum_j' N_j p_{ji} . \quad (100)$$

no. of atoms/ cm^3 /sec leaving state i	no. of atoms/ cm^3 /sec entering state i
---	--

\sum_j' indicates that we do not count $j = i$.

In the steady state, $\frac{dN_i}{dt} = 0$ and

$$N_i \sum_j' p_{ij} = \sum_j' N_j p_{ji} . \quad (101)$$

The further constraint implied by thermodynamic equilibrium is that the equality holds separately for each j .

It is often convenient to consider the ratio of a population or transition rate to the value that quantity would have in thermodynamic equilibrium at the same reference temperature. Denote this ratio by the superscript*, and denote the equilibrium value by superscript^(°). Then

$$N_i^* = \frac{N_i}{N_i^{(°)}}, \quad p_{ij}^* = \frac{p_{ij}}{p_{ij}^{(°)}}. \quad (102)$$

Note that the starred quantities are dimensionless.

Equation 101 can be rewritten,

$$\sum_j' N_i p_{ij} \left(1 - \frac{N_j^* p_{ji}^*}{N_i^* p_{ij}^*} \right) = 0, \quad (103)$$

where we have used the relation $N_i^{(°)} p_{ij}^{(°)} = N_j^{(°)} p_{ji}^{(°)}$. As the starred transition rates go to unity, the starred populations must also approach unity.

Returning to Equation 101 it is convenient to separate the continuous states. We assume that the distribution of the continuous states is in LTE (i.e., that they have a Maxwellian velocity distribution), and integrate over the continuous states counting the result as one state, which is labeled k . Note that the dimensions of the continuum state differ from those of the bound states, since a bound particle undergoes a transition to two continuum particles. Since in a pure hydrogen gas the number of electrons equals the number of protons, the population of the continuum state is N_e^2 . Equation 101 is rewritten,

$$N_i \left(\sum_{j=1}^N p_{ij} + p_{ik} \right) = \sum_{j=i}^N N_j p_{ji} + N_e^2 p_{ki}. \quad (104)$$

Dividing by N_e^2 and letting

$$n_i = \frac{N_i}{N_e^2} \quad (105)$$

we have

$$n_i \left(\sum_{j=1}^N p_{ij} + p_{ik} \right) = \sum_{j=1}^N n_j p_{ji} + p_{ki}. \quad (106)$$

For N bound states, there are just N linearly independent equations. There are in total $N + 1$ states, counting the continuum, but one equation is redundant. This is because the total number density of the particles has not as yet been specified so that, at best, the N ratios between the $N + 1$ states can be found. The N equations are defined by letting $i = 1, 2, \dots, N$ in Equation 106. The $N + 1$ st equation is

$$N = \sum_{i=1}^N n_i + N_e = N_o + N_e , \quad (107)$$

where N has been obtained from the integration of the equation of hydrostatic equilibrium.

After solving Equations 106 for the n_i , N_e is calculated from

$$N_e = \frac{\sqrt{1 + 4 n_o N} - 1}{2 n_o} \quad (108)$$

where

$$n_o = \frac{N_o}{N_e^2} . \quad (109)$$

The p_{ij} are made up of radiative transitions (r_{ij}) and collisional transitions (c_{ij}). The collisional transitions themselves depend linearly on the electron density N_e . In the calculation of the steady state populations, we first used the equilibrium value of N_e in the collisional rates, calculated the steady state value of N_e , recalculated the collisional rates, and iterated, until N_e stabilized to 1 part in 10^4 .

Finally, there remains one important question. How many bound states must be used? This was answered empirically by calculating the steady state populations first using only 1 bound state, and then successively adding bound states until 10 bound states had been added. The calculation was done using a radiation field of dilute Planck radiation with a dilution factor of 0.5. The result is that the populations stabilize at 3 bound states. That is, the addition of a fourth bound state does not alter the steady state populations of the first 3 bound states. If collisional transitions are neglected entirely, 6 or 7 bound states are sufficient to calculate the populations of the first 5 bound states to within 1 percent. Because it required little additional effort, 10 bound states were used in the final calculations. The effects of successively adding bound states is displayed in Figures 19 and 20 and in Tables 4 and 5.

In the following sections we present the formulae for the radiative and collisional rates, and apply them to a few simple examples.

RADIATIVE RATES

In the formulae for the radiative rates, we use the Einstein notation for the transition probabilities normalized for the radiation intensity. It is also useful to introduce dilution factors (W) which measure the deviation of the local radiation field from equilibrium radiation at the local temperature.

We remind the reader that the frequency ν is measured in units of R , and is thus dimensionless.

We present first the rates for transitions between two bound states, and second for transitions between a bound state and the continuum.

Bound-Bound Radiative Rates

In equilibrium,

$$r_{ij} = B_{ij} B_{\nu_{ij}}(T)$$

and

$$r_{ji} = A_{ji} + B_{ji} B_{\nu_{ij}}(T) .$$

If the radiation field is not in equilibrium, we must first replace $B_{\nu_{ij}}(T)$ with the actual local radiation field J_{ν} , and second we must take into account the absorption profile. That is, transitions connecting the states i and j take place over a frequency interval about ν_{ij} . This leads to an absorption profile whose breadth is affected by a variety of processes; doppler shifts, radiation damping, collisional damping, stark effect, etc. Only the doppler broadening is taken into account. As we show in the next chapter, broadening of the lines does not qualitatively alter the results.

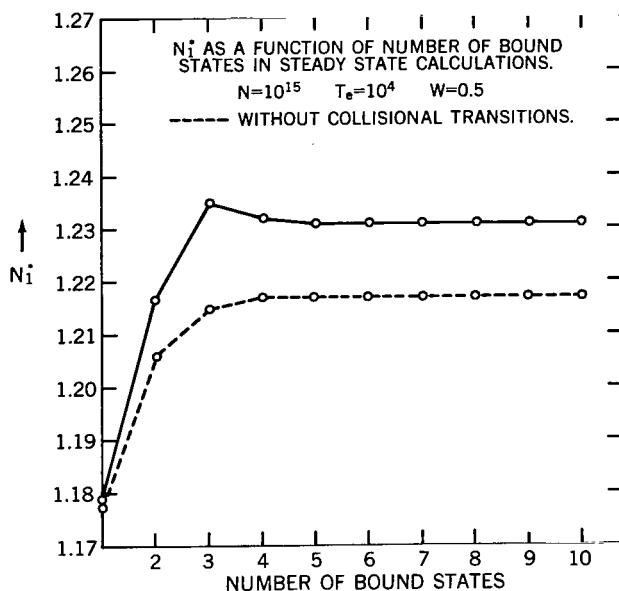


Figure 19— N_i^* as a function of the number of bound states used in the steady state equations.

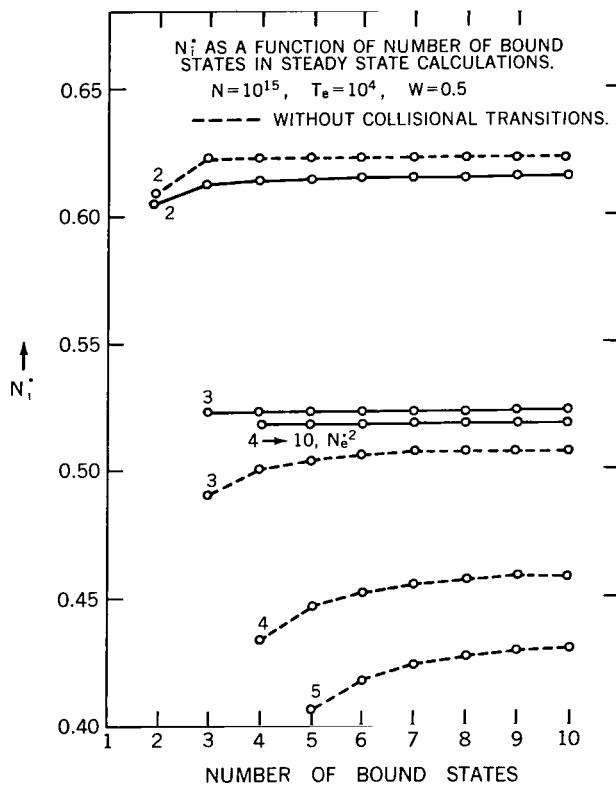


Figure 20— N_i^* as a function of the number of bound states used in the steady state equations.

Table 4

Ratio of Steady State to LTE Populations (N_i^*)
as a Function of Number of Bound States Used in Steady State Equations.

$$N = 10^{15}$$

$$T_e = 10^4 \text{ °K}$$

$$W = 0.5$$

	Number of Bound States									
	1	2	3	4	5	6	7	8	9	10
N_1^*	1.178	1.206	1.215	1.217	1.217	1.217	1.217	1.217	1.217	1.217
N_2^*		0.605	0.612	0.613	0.613	0.614	0.614	0.614	0.614	0.614
N_3^*			0.523	0.523	0.523	0.523	0.523	0.524	0.524	0.524
N_4^*				0.518	0.517	0.517	0.517	0.517	0.517	0.517
N_5^*					0.517	0.517	0.517	0.517	0.517	0.517
N_6^*						0.517	0.517	0.517	0.517	0.517
N_7^*							0.517	0.517	0.517	0.517
N_8^*								0.517	0.517	0.517
N_9^*									0.517	0.517
N_{10}^*										0.517
N_e^*	0.769	0.732	0.721	0.719	0.719	0.719	0.719	0.719	0.719	0.719
N_e^{*2}	0.591	0.536	0.520	0.517	0.517	0.517	0.517	0.517	0.517	0.517

Table 5

Ratio of Steady State to LTE Populations (N_i^*)
as a Function of Number of Bound States Used in Steady State Equations
(collisional transitions have been neglected).

$$N = 10^{15}$$

$$T_e = 10^4 \text{ °K}$$

$$W = 0.5$$

	Number of Bound States									
	1	2	3	4	5	6	7	8	9	
N_1^*	1.179	1.217	1.235	1.232	1.231	1.231	1.231	1.231	1.231	1.231
N_2^*		0.609	0.622	0.621	0.621	0.621	0.621	0.621	0.621	0.621
N_3^*			0.491	0.501	0.504	0.506	0.507	0.507	0.508	
N_4^*				0.434	0.447	0.452	0.455	0.456	0.458	
N_5^*					0.407	0.418	0.424	0.427	0.429	
N_6^*						0.392	0.401	0.406	0.410	
N_7^*							0.383	0.390	0.395	
N_8^*								0.377	0.383	
N_9^*									0.373	
N_{10}^*										
N_e^*	0.768	0.719	0.695	0.694	0.693	0.693	0.692	0.692	0.692	0.692
N_e^{*2}	0.590	0.517	0.483	0.482	0.480	0.480	0.479	0.479	0.479	0.479

The doppler profile can be written

$$\phi_{ij}(\nu) = \pi^{-\frac{1}{2}} \Delta_{ij}^{-1} e^{-\left(\frac{\nu - \nu_{ij}}{\Delta_{ij}}\right)^2} \quad (110)$$

where

$$\Delta_{ij} = \left(\frac{2kT}{m_H c^2} \right)^{\frac{1}{2}} \nu_{ij} = 0.4286 \times 10^{-6} T^{\frac{1}{2}} \nu_{ij} .$$

The upward transition rate is given by

$$r_{ij} = B_{ij} \int_{-\infty}^{+\infty} \phi_{ij}(\nu) J_\nu d(R\nu) \quad (111)$$

where

$$\int_{-\infty}^{+\infty} \phi_{ij}(\nu) d(R\nu) = 1 .$$

The results are easier to interpret if we introduce

$$W_{ij} = \frac{\int_{-\infty}^{+\infty} \phi_{ij}(\nu) J_\nu d\nu}{\int_{-\infty}^{+\infty} \phi_{ij}(\nu) B_\nu d\nu} . \quad (112)$$

With respect to the slowly varying function B_ν , $\phi_{ij}(\nu)$ is essentially a delta-function, so that we can write

$$\int_{-\infty}^{+\infty} \phi_{ij}(\nu) B_\nu d\nu = B_{\nu_{ij}} . \quad (113)$$

In terms of the above definitions the radiative rates for the bound-bound transitions can be written

$$r_{ij} = B_{ij} W_{ij} B_{\nu_{ij}} \quad (114)$$

and

$$r_{ji} = A_{ji} + B_{ji} W_{ij} B_{\nu_{ij}} . \quad (115)$$

The formulae for the Einstein coefficients A_{ij} , B_{ji} , and B_{ij} have been given in Chapter 2.

In the limits $U_{ij} \gg 1$ and $U_{ij} \ll 1$ we can make up Table 6 for R_{ij} and R_{ji} . For $T = 10^4 \text{°K}$, the first limit is applicable for all transitions for which $i \leq 3$ while the second limit is appropriate to transitions for which $i \geq 5$.

Table 6
Radiative Rates in the Limits $U_{ij} \gg 1$ And $U_{ij} \ll 1$.

$U_{ij} \gg 1$		
$j \approx i$		
$j \gg i$		
$r_{ij} \approx 1.6 \times 10^{10} W_{ij} \times \frac{e^{-U_{ij}}}{i^3 j (j^2 - i^2)}$	$\frac{e^{-U_{ij}}}{2j^5}$	$\frac{e^{-U_{ij}}}{j^3}$
$r_{ji} \approx 1.6 \times 10^{10} \times \frac{1}{ij^3 (j^2 - i^2)}$	$\frac{1}{2j^5}$	$\frac{1}{j^5}$
$U_{ij} \ll 1$		
$j \approx i$		
$j \gg i$		
$r_{ij} \approx \frac{1.6 \times 10^{10} W_{ij}}{U_H} \times \frac{j}{i (j^2 - i^2)^2}$	$\frac{1}{4j^2}$	$\frac{1}{ij^3}$
$r_{ji} \approx 1.6 \times 10^{10} \times \frac{1}{ij^3 (j^2 - i^2)}$	$\frac{1}{2j^5}$	$\frac{1}{ij^5}$

Bound-Free Radiative Rates

The formulae for Bound-Free Radiative Rates are

$$r_{ik} = (7.8728 \times 10^9) i^{-5} W_{ik} \int_{U_i}^{\infty} \frac{dU}{U} \frac{1}{e^U - 1} \quad (116)$$

where

$$W_{ik} = \frac{\int_{\nu_i}^{\infty} J_{\nu} \nu^{-4} d\nu}{\int_{\nu_i}^{\infty} B_{\nu} \nu^{-4} d\nu}.$$

We have neglected the Gaunt factors in the transition probability, which are always around unity, varying between 0.8 and 1 from the ground states to the higher excited states. The integrals over U can be evaluated in terms of the Exponential Integral.

$$r_{ki} = (7.8728 \times 10^9) l^3 e^{U_i} i^{-3} \left[E_1(U_i) + W_{ki} \int_{U_i}^{\infty} \frac{dU}{U} \frac{e^{-U}}{e^U - 1} \right] \quad (117)$$

where

$$W_{ki} = \frac{\int_{\nu_i}^{\infty} e^{-U} J_{\nu} \nu^{-4} d\nu}{\int_{\nu_i}^{\infty} e^{-U} B_{\nu} \nu^{-4} d\nu}.$$

The formulae for r_{ik} and r_{ki} are obtained from Equations 39 and 40 of Chapter 2. For example,

$$r_{ik} = \int_{\nu_i}^{\infty} J_{\nu} B_{ik} \frac{dk}{d(R\nu)} d(R\nu). \quad (118)$$

The term prefaced by W_{ki} corresponds to induced recombination and is of the order $E_1(2U_i)$. For $U_i \geq 1$, it can be neglected with respect to $E_1(U_i)$.

We note that for $U_i \geq 1$, we can write

$$r_{ik} \approx W_{ik} i^{-3} 7.9 \times 10^9 e^{-U_i} U_H^{-1}, \quad (119)$$

$$r_{ki} \approx i^{-1} 5.2 \times 10^{-14} U_H^{1/2}. \quad (120)$$

COLLISIONAL RATES

In the calculation of collisional rates, only electrons have been taken into account as incoming particles, and they have been assumed to have a Maxwellian velocity distribution. The number

of collisional transitions per cm³ per sec exciting the target atom from the ith state to the jth state is

$$N_i c_{ij} = N_i N_e \int_0^\infty f(v) \sigma_{ij}(v) v dv , \quad (121)$$

where $f(v)$ is the fraction of electrons with velocity v and $\sigma_{ij}(v)$ is the collision cross-section in cm².

It is usual to set

$$\sigma_{ij} = \pi a_0^2 Q_{ij} \quad (122)$$

where a_0 is the Bohr radius ($a_0 = 0.52917 \times 10^{-8}$ cm) and to change the integration variable to the energy. Noting that

$$f(E) dE = 2\pi^{-1/2} \beta^{3/2} e^{-\beta E} E^{1/2} dE \quad (123)$$

[where $\beta = 1/(kT)$] , and that $v = (2E/m)^{1/2}$,

$$c_{ij} = N_e \left(\frac{8}{\pi m} \right)^{1/2} \pi a_0^2 \beta^{3/2} \int_0^\infty Q_{ij}(E) e^{-\beta E} E dE . \quad (124)$$

We define a dimensionless parameter Γ_{ij} by

$$\Gamma_{ij} = \beta^2 e^{\beta E_{ij}} \int_0^\infty Q_{ij}(E) e^{-\beta E} E dE , \quad (125)$$

where E_{ij} is the energy difference between the ith and jth states. In terms of Γ_{ij}

$$c_{ij} = N_e c_0 T^{1/2} e^{-\beta E_{ij}} \Gamma_{ij} , \quad (126)$$

where $c_0 = \pi a_0^2 [(8k)/(\pi m)]^{1/2} = 5.465 \times 10^{-11}$ cm³/sec. The purpose of introducing Γ_{ij} , is that defined in this way, Γ_{ij} is relatively independent of the temperature. For example, if we represent Q_{ij} by the classical (Thomson) collision cross-section, Γ_{ij} is, in the case where $\beta E_{ij} \gg 1$ completely independent of the temperature.

The Thomson cross-section is

$$Q_{ij}(E) = \left(\frac{E_H}{E_{ij}} \right)^2 \left(\frac{1}{\epsilon} - \frac{1}{\epsilon^2} \right) \quad (127)$$

where $E_H = hR$ = ionization energy of hydrogen

$$\epsilon = E/E_{ij} .$$

Using this cross-section

$$\Gamma_{ij} = \left(\frac{E_H}{E_{ij}}\right)^2 U_{ij} \left[1 - U_{ij} e^{U_{ij} E_1 / U_{ij}}\right] ,$$

where $U_{ij} = \beta E_{ij}$.

For $U_{ij} \gg 1$, $U e^U E_1(U) \rightarrow 1 - \frac{1}{U}$ and

$$\Gamma_{ij} = \frac{1}{\nu_{ij}^2} .$$

For the $1 \rightarrow 2$ transition, $\Gamma_{12} \approx 1.8$. Since we will be interested in temperatures of about $10,000^\circ K$ ($\beta \approx 1 \text{ ev}^{-1}$) and $E_{12} \approx 10 \text{ ev}$, this is the applicable limit. For comparison, a numerical integration over the experimental collision cross-section yields Table 7 for Γ_{12} as a function of T . Since the available data on collision cross-sections are poor, we will neglect the variation of Γ with temperature, and use the value for $10,000^\circ K$ throughout the atmosphere.

Table 7

Γ_{12} as a Function of Temperature.

$T(^{\circ}K)$	(T)
6,000	3.0
8,000	2.9
10,000	2.8
12,000	2.6
14,000	2.5
16,000	2.4
18,000	2.4
20,000	2.3
25,000	2.1
30,000	2.0

Finally, the collisional rates for the steady state equations are given by:

$$c_{ij} = N_e c_0 T^{1/2} e^{-U_{ij}} \Gamma_{ij} \quad i < j , \quad (128)$$

$$c_{ji} = j^{-2} i^2 N_e c_0 T^{1/2} \Gamma_{ij} \quad i < j , \quad (129)$$

$$c_{ik} = N_e c_0 T^{1/2} e^{-U_i} \Gamma_{ik} , \quad (130)$$

$$c_{ki} = i^2 c_0 N_e l^3 T^{1/2} \Gamma_{ik} . \quad (131)$$

The Γ 's were obtained by numerically integrating Equation 125 using tabular values of the collision cross-section Q . Q_{12} and Q_{1k} have been determined experimentally by Fite et al. (References 5-7). The remaining Q_{ij} were calculated from an approximation developed by Milford (Reference 8), and the classical Q (Equation 127) was used for the remaining Q_{ik} . The values of Γ used in the calculation are presented in Table 8.

For comparison with the radiative rates, we insert numerical values for the constants, combine T into U_H , and use (just for this comparison) the classical value of Γ_{ij} . Then:

$$c_{ij} \approx N_e \nu_{ij}^{-2} 2.2 \times 10^{-8} e^{-U_{ij}} U_H^{-\frac{1}{2}}, \quad (132)$$

$$c_{ji} \approx N_e j^{-2} i^2 \nu_{ij}^2 2.2 \times 10^{-8} U_H^{-\frac{1}{2}}, \quad (133)$$

$$c_{ik} \approx N_e i^4 2.2 \times 10^{-8} e^{-U_i} U_H^{-\frac{1}{2}}, \quad (134)$$

$$c_{ki} \approx N_e i^6 1.5 \times 10^{-31} U_H. \quad (135)$$

For the lower states ($i \leq 3$) where $U_{ij} \gg 1$, we find

$$\frac{r_{ij}}{c_{ij}} \approx \frac{r_{ji}}{c_{ji}} \approx \frac{7 \times 10^{17}}{N_e} U_H^{\frac{1}{2}} \frac{j^2 - i^2}{i^7 j^5},$$

$$\frac{r_{ik}}{c_{ik}} \approx \frac{r_{ki}}{c_{ki}} \approx \frac{4 \times 10^{17}}{N_e} U_H^{-\frac{1}{2}} i^{-7}.$$

The W have been neglected since they at most contribute a factor of 2.

Setting $U_H = 4$ for $T \approx 10^4$ °K, we have approximately

$$\frac{r_{ij}}{c_{ij}} \approx \frac{3 \times 10^{18}}{N_e} \times \frac{j^2 - i^2}{i^7 j^5}$$

$$\frac{r_{ik}}{c_{ik}} \approx \frac{1 \times 10^{17}}{N_e} i^{-7}.$$

Table 8
 Γ_{ij} and Γ_{ik} for $T = 10^4$ °K.

i	j	Γ_{ij}	i	j	Γ_{ij}	i	Γ_{ik}
1	2	2.6	4	5	1.9×10^3	1	1.0
	3	6.7×10^{-1}		6	2.4×10^2	2	1.6×10^1
	4	2.5×10^{-1}		7	8.2×10^1	3	8.1×10^1
	5	1.2×10^{-1}		8	3.9×10^1	4	2.6×10^2
	6	6.9×10^{-2}		9	2.2×10^1	5	6.3×10^2
	7	4.3×10^{-2}		10	1.4×10^1	6	1.3×10^3
	8	2.8×10^{-2}		5	5.8×10^3	7	2.4×10^3
	9	2.0×10^{-2}		7	7.1×10^2	8	4.1×10^3
	10	1.4×10^{-2}		8	7.2×10^2	9	6.6×10^3
	3	6.1×10^1		9	9.9×10^1	10	1.0×10^4
2	4	1.2×10^1	10	5.5	10^1		
	5	4.5		7	1.5×10^4		
	6	2.3		8	1.8×10^3		
	7	1.3		9	5.1×10^2		
	8	8.4×10^{-1}		10	2.2×10^2		
	9	5.7×10^{-1}		7	8×10^4		
	10	4.1×10^{-1}		9	3.9×10^3		
	4	4.2×10^2		10	1.1×10^3		
	5	6.6×10^1		8	9×10^4		
	6	2.4×10^1		10	7.9×10^3		
3	7	1.2×10^1	9	10	1.1×10^5		
	8	1.2×10^1		10			
	9	4.5					
	10	3.1					

$j \approx i$	$j \gg i$
$\frac{1}{j^{11}}$	$\frac{1}{i^7 j^3}$

At the depth in the atmosphere where the lines and the Lyman continuum are formed $N_e < 10^{11}$, and the radiative rates are much larger than the collisional rates. At the depth where the flux is formed, $N_e \approx 10^{14}$, and collisions are still not important for the first 2 states, but begin to play a role for the third and higher states. But, as we shall see later, even here, their role is minor.

STEADY STATE POPULATION FOR DILUTE PLANCK RADIATION FIELDS

Before proceeding with the calculations of the steady state populations using the atmospheric radiation fields, it is instructive to go through some simple examples using dilute Planck radiation fields.

Let us first consider an atom possessing only 2 states; the ground state and the continuum. The steady state equation for the ratio n_1 is

$$n_1 [r_{1k} + c_{1k}] = r_{k1} + c_{k1}. \quad (136)$$

If we write

$$\begin{aligned} n_1 &= n_1^* n_1^{(o)} \\ r_{1k} &= r_{1k}^* r_{1k}^{(o)} = W_{1k} r_{1k}^{(o)} \\ r_{k1} &= r_{k1}^{(o)} \text{ (neglecting induced recombinations),} \end{aligned}$$

and remember that the c 's are in LTE ($c = c^{(o)}$) we have

$$n_1^* [n_1^{(o)} W_{1k} r_{1k}^{(o)} + n_1^{(o)} c_{1k}] = r_{k1}^{(o)} + c_{k1}, \quad (137)$$

but

$$n_1^{(o)} r_{1k}^{(o)} = r_{k1}^{(o)} \quad \text{and} \quad n_1^{(o)} c_{1k} = c_{k1},$$

so

$$n_1^* = \frac{\frac{r_{k1}^{(o)}}{c_{k1}}}{1 + \frac{r_{k1}^{(o)}}{c_{k1}}} = \frac{\frac{r_{k1}^{(o)}}{c_{k1}}}{1 + W_{1k} \frac{r_{k1}^{(o)}}{c_{k1}}}. \quad (138)$$

Since

$$\begin{aligned} \frac{r_{k1}^{(o)}}{c_{k1}} &\gg 1, \\ n_1^* &\approx \frac{1}{W_{1k}}. \end{aligned} \quad (139)$$

$$n_1^* = \frac{N_1}{N_e^2} \sqrt{\frac{N_1^{(0)}}{N_e^{(0)2}}}$$

is denoted b_1 by Menzel (Reference 1) and by Thomas and Athay (Reference 2).

If we now consider the second state, we find that for $N_e < 10^{14}$ we can still neglect collisional transitions and also all transitions to the continuum. Then n_2^* is just given by

$$n_2^* = w_{12} n_1^*. \quad (140)$$

Table 9
Steady State Atomic Populations.

$T = 10^4 \text{ } ^\circ\text{K}$

($W = 0.5$ for all transitions except $1 \rightarrow 2, 1 \rightarrow K$)

N_e		$W_{1k} = 0.5$	$W_{1k} = 0.5$	$W_{1k} = 1.0$
		$W_{12} = 0.5$	$W_{12} = 1.0$	$W_{12} = 1.0$
$10^{10}/\text{cm}^3$	n_1^*	2.9 (2.0)	1.8 (2.0)	1.3 (1.0)
	n_2^*	1.5 (1.0)	1.8 (2.0)	1.3 (1.0)
$10^{12}/\text{cm}^3$	n_1^*	2.8 (2.0)	1.3 (2.0)	1.1 (1.0)
	n_2^*	1.4 (1.0)	1.3 (2.0)	1.1 (1.0)
$10^{14}/\text{cm}^3$	n_1^*	2.5 (2.0)	1.1 (2.0)	1.0 (1.0)
	n_2^*	1.3 (1.0)	1.1 (2.0)	1.0 (1.0)

Table 9 gives a sample of the calculations which were performed using 10 bound states. The approximations (Equations 139 and 140) are in parentheses.



Chapter 5

RESULTS: STEADY STATE ATOMIC POPULATIONS IN AN AO STAR ATMOSPHERE

Finally we review the calculations of the steady state atomic populations, using the monochromatic radiation fields, densities and temperatures obtained from the model atmosphere. The ratios (N_i^*) of the steady state populations to the LTE populations are displayed as a function of optical depth in Figure 21. In this case, the integration of the line profile of J_ν was replaced by the value of J_ν at the center of the line. We shall return to this approximation presently.

For discussing the main features of Figure 21, it is useful to have in mind the run of the monochromatic optical depths. Figure 22 is a chart of τ_ν vs. τ , where τ is defined by the Rosseland mean. Notice that the resonance lines ($1 \rightarrow 2, 1 \rightarrow 3, \dots$) become opaque at $\tau = 10^{-8}$, the Lyman continuum ($1 \rightarrow \infty$) becomes opaque at $\tau = 10^{-6}$, the Balmer lines ($2 \rightarrow 3, 2 \rightarrow 4, \dots$) become opaque at $\tau = 10^{-4}$, while for the Balmer and Paschen continua, τ_ν is approximately equal to τ .

At the surface, the ground state is overpopulated. This can be understood as follows. Where the Lyman continuum is transparent, photo-ionizations from the ground state occur at a lesser rate than they would in LTE, while recombinations — being independent of the radiation field — occur at the same rate as in LTE: thus the ground state is overpopulated. The higher states are overpopulated or underpopulated depending on whether they are more closely

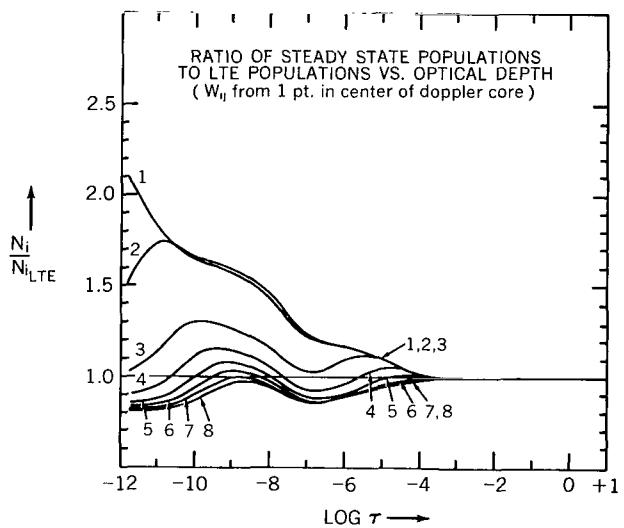


Figure 21—Ratio (N_i^*) of steady state to LTE populations vs. optical depth (W_{ij} from 1 pt. in center of doppler core).

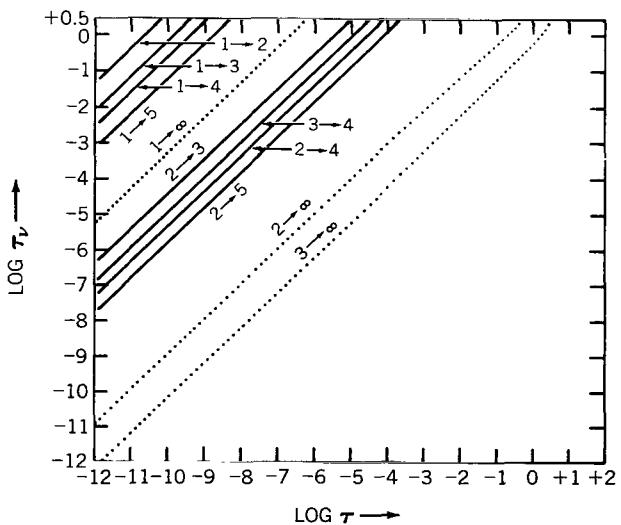


Figure 22— τ_ν vs. τ .

coupled to the ground state or to the continuum. Since the total population is fixed, and the ground state has a surplus, the highest bound states (or at least the continuum state) must have a deficit.

Descending into the atmosphere, Lyman α becomes opaque at $\tau = 10^{-10}$ and thus N_1^* and N_2^* coalesce. Figure 23 illustrates, for the case of dilute Planck radiation, that N_1^* and N_2^* coalesce as W_{12} goes to 1, and that N_1^* and N_2^* approach 1 as W_{1K} goes to 1. For the higher states there occurs a last rise in N_i^* at $\tau = 10^{-5}$ where the Balmer lines become opaque. Since the second state is already completely tied to the ground state, this has the effect of further strengthening the coupling of the higher states with the ground states. The most striking feature of the $N_i^*(\tau)$ is that they converge to unity at as small an optical depth as 10^{-3} .

Before attempting to explain this, it is worthwhile to examine the approximations that have been made in calculating the steady state populations. In the first place, the approximate treatment of the line profiles (by considering only the one frequency at the line center) had the effect of making the lines more opaque. As a check, the calculation was repeated with a 5 point quadrature of the line profiles. The result is shown in Figure 24. The lines, in fact, become more transparent, but the trend is unchanged; i.e. the populations still approach their LTE values at $\tau = 10^{-3}$.

Secondly, the equation of hydrostatic equilibrium was integrated for $g = 10^3$. This value, although too low for a main sequence AO star, had been chosen to accentuate the departures from

LTE. Consequently, the densities were too low, and thus the collisional rates were also too low. The integration was repeated for $g = 10^4$, and these densities were used in the calculation of the steady state populations.

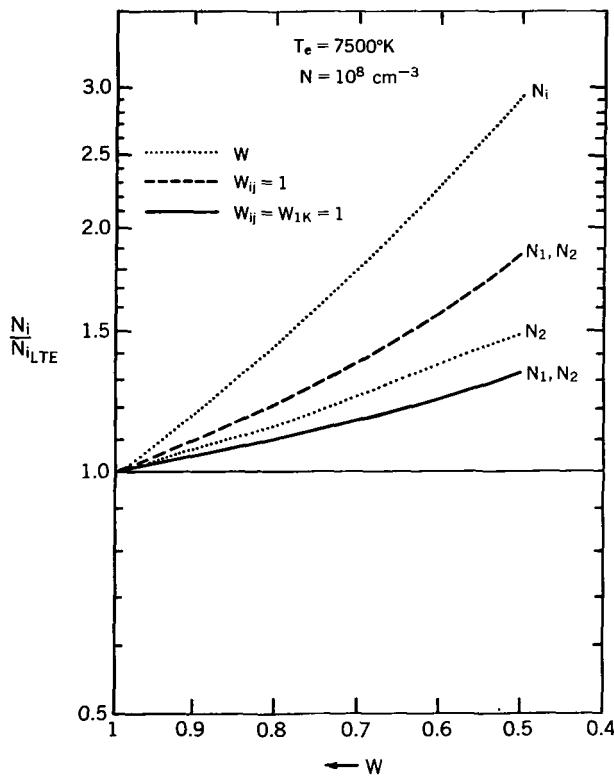


Figure 23—Steady state populations as a function of W .

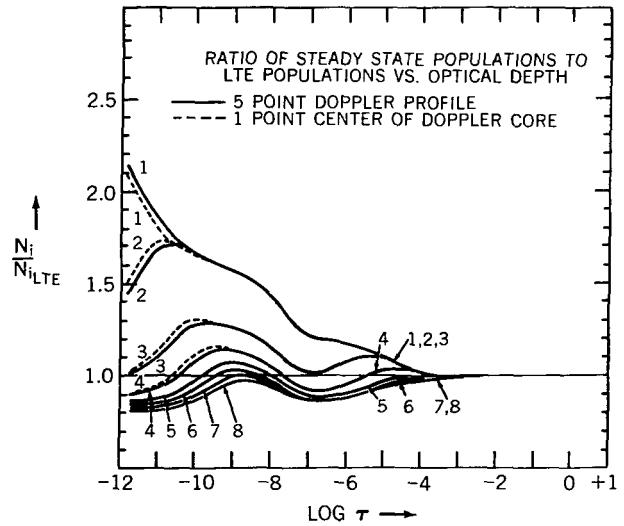


Figure 24—Ratio (N_i^*) of steady state to LTE populations vs. optical depth (W_{ij} from 5 pt. doppler profile) (W_{ij} from 1 pt. in center of doppler core).

Table 10

N_i^* as a Function of Collisional Rates
 (all collisional rates multiplied by γ : $\gamma = 0, 1, 100$),
 N = Total Number Density, $N_i^* = N_i / N_{i_{LTE}}$.

τ	N	γ	N_1^*	N_2^*	N_3^*	N_4^*	N_5^*
1.58×10^{-12}	6.19×10^7	0	2.16	1.45	1.01	0.90	0.86
		1	2.16	1.45	1.01	0.90	0.86
		100	2.18	1.46	1.02	0.91	0.87
5.01×10^{-10}	1.10×10^9	0	1.60	1.61	1.28	1.14	1.06
		1	1.60	1.61	1.28	1.15	1.06
		100	1.61	1.62	1.29	1.15	1.07
3.98×10^{-6}	1.12×10^{11}	100	1.11	1.11	1.10	0.98	0.91
		1	1.14	1.14	1.11	1.00	0.94
		100	1.12	1.12	1.09	0.99	0.97
3.98×10^{-3}	1.37×10^{13}	0	1.01	1.01	1.01	1.02	1.03
		1	1.00	1.00	1.00	1.00	1.00
		100	1.00	1.00	1.00	1.00	1.00
2.51×10^{-1}	9.96×10^{13}	0	1.01	1.01	1.01	1.01	1.01
		1	1.00	1.00	1.00	1.00	1.00
		100	1.00	1.00	1.00	1.00	1.00
1.00	1.02×10^{14}	0	1.00	1.00	1.01	1.01	1.01
		1	1.00	1.00	1.00	1.00	1.00
		100	1.00	1.00	1.00	1.00	1.00
2.51	1.44×10^{14}	0	1.00	1.00	1.00	1.00	1.00
		1	1.00	1.00	1.00	1.00	1.00
		100	1.00	1.00	1.00	1.00	1.00

The N_i^* were practically unchanged, indicating that either collisions were relatively unimportant, or that the adopted collision cross-sections were greatly in error. In order to test the effect of changing the collision cross-sections, the steady state populations were evaluated with collisional rates multiplied by an arbitrary factor of 100, and also with collisional rates set equal to zero. The results for various optical depths are shown in Table 10 and Figure 25. The difference in N_i^* between no collisional transitions and collisional rates multiplied by a factor of 100 is at most a few percent. Accordingly, collisions are definitely of minor importance. Therefore, since the populations are in LTE at $\tau = 10^{-3}$,

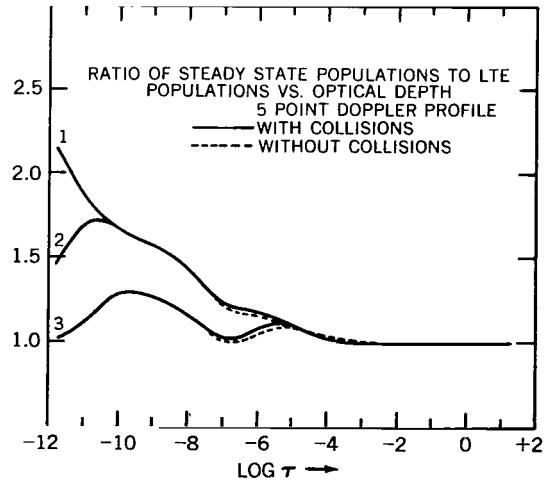


Figure 25—Ratio (N_i^*) of steady state to LTE populations vs. optical depth (with and without collisions).

the radiative rates must be in LTE. This turns out to be the case. In Table 11, the dilution factors (W) at $\tau = 10^{-3}$ are given for the 10 transitions to the continuum. The dilution factors for the line transitions are all one. We remind the reader that W_{ij} is the ratio of the radiative rate for the $i \rightarrow j$ transition, to the value this rate would have in LTE. For a line transition, W_{ij} is very nearly equal to the ratio of J_ν to B_ν at the line center. For a transition to the continuum, W_{ik} is given by

$$W_{ik} = \frac{\int_{\nu_i}^{\infty} J_\nu \nu^{-4} d\nu}{\int_{\nu_i}^{\infty} B_\nu \nu^{-4} d\nu}.$$

The following argument explains why W_{ij} and W_{ik} equal 1. Expanding $B_\nu(t_\nu)$ about τ_ν (see Equation 14, Chapter 2) and retaining only the two leading terms, we obtain the following approximation to J_ν .

$$J_\nu(\tau) \approx B_\nu(\tau) \left[1 - \frac{1}{2} E_2(\tau_\nu) \right] + \frac{1}{2k_\nu} \frac{dB_\nu}{d\tau} \left[E_3(\tau_\nu) + \tau_\nu E_2(\tau_\nu) \right]. \quad (141)$$

In the limits $\tau_\nu \rightarrow 0$ and $\tau_\nu \gg 1$, this approximation reduces to

$$J_\nu(\tau) \approx \frac{1}{2} B_\nu(\tau) + \frac{1}{4k_\nu} \frac{dB_\nu}{d\tau} \quad \tau_\nu \rightarrow 0, \quad (142)$$

$$J_\nu(\tau) \approx B_\nu(\tau) + 0(e^{-\tau_\nu}) \quad \tau_\nu \gg 1. \quad (143)$$

Values of k_ν for various frequencies and values of τ_ν using the approximation $\tau_\nu = k_\nu \tau$ are listed in Table 12.

All the lines and the Lyman continuum are optically deep at $\tau = 10^{-3}$. Therefore, from Equation 143, $J_\nu = B_\nu$ and $W = 1$. As Figure 23 suggests, this suffices to bring the steady state populations to within 10 percent of their LTE values. Thus we have disposed of the optically thick transitions. On the other hand, although the Balmer and Paschen continua are optically thin, there too W_{2k} and W_{3k} are about 1. In this case, as illustrated in Figures 26 and 27, J_ν does not equal B_ν for all frequencies in the range of integration, but $J_\nu < B_\nu$ at the head of the continuum and $J_\nu > B_\nu$ at the tail of the continuum. The variation happens to make W equal 1. This crossover can be understood with the aid of Equation 142. The first term in this equation represents the fact that

Table 11
Dilution Factors at $\tau = 10^{-3}$.

i	W_{ik}
1	1.00
2	1.00
3	0.95
4	0.75
5	0.67
6	0.63
7	0.61
8	0.61
9	0.60
10	0.60

Table 12
 k_ν and τ_ν at $\tau = 10^{-3}$.

Frequency	k_ν	τ_ν at $\tau = 10^{-3}$
Head of Paschen continuum	1	10^{-3}
Head of Balmer continuum	10^{-2}	10^{-2}
Center of Balmer lines	10^{+5}	10^{+2}
Head of Lyman continuum	10^{+7}	10^{+4}
Center of Lyman lines	10^{+10}	10^{+7}

there is no contribution to J_ν from incident radiation (I_ν goes to zero as τ_ν goes to zero) and thus J_ν is but $\frac{1}{2}B_\nu$. The second term gives the contribution to J_ν from the higher temperatures in the interior. At the head of the continuum, k_ν is relatively large, and consequently the second term is relatively small (i.e. we are not seeing into the temperature gradient), and thus $J_\nu < B_\nu$. As we proceed to higher frequencies, k_ν becomes progressively smaller ($k_\nu \propto \nu^{-3}$) and the contribution from the interior offsets the loss of incident radiation; consequently J_ν becomes greater than B_ν .

This set of circumstances reconciles the apparent contradiction that the radiative rates are in equilibrium while at the same time the frequency dependence of the flux changes with optical depth. No such contradiction arises for the optically thick transitions ($k_\nu \gg 1$) since $F_\nu \propto 1/k_\nu$, so that there is very little flux in these frequencies. For the optically thin transitions, which carry most of the flux, $J_\nu \neq B_\nu$, hence,

$$\frac{1}{4} \frac{dF_\nu}{d\tau} = k_\nu (J_\nu - B_\nu) \neq 0 .$$

To evaluate the observable consequences of departures from LTE, we compute the emergent flux, using the steady state populations in the absorption coefficients and the source functions. The correction to the LTE coefficients of absorption and emission are obtained as follows. Considering a transition between a lower state i and an upper state j at the frequency $\nu = |E_j - E_i|/hR$, the contribution of this transition to the emission and absorption coefficients is

$$\epsilon_\nu = \frac{N_j A_{j|i} h R \nu}{4\pi} ,$$

$$K_\nu = \frac{(N_i B_{i|j} - N_j B_{j|i}) h R \nu}{4\pi} ,$$

or, neglecting degeneracy and setting $B_{i|j} = B_{j|i}$

$$K_\nu = \frac{N_i B_{i|j} \left(1 - \frac{N_j}{N_i}\right) h R \nu}{4\pi} .$$

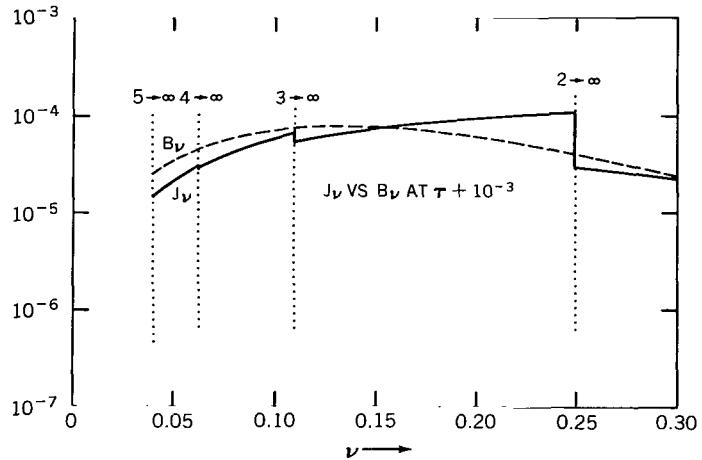


Figure 26— J_ν / B_ν vs. ν at $\tau = 10^{-3}$ ($0 \leq \nu \leq 0.30$).

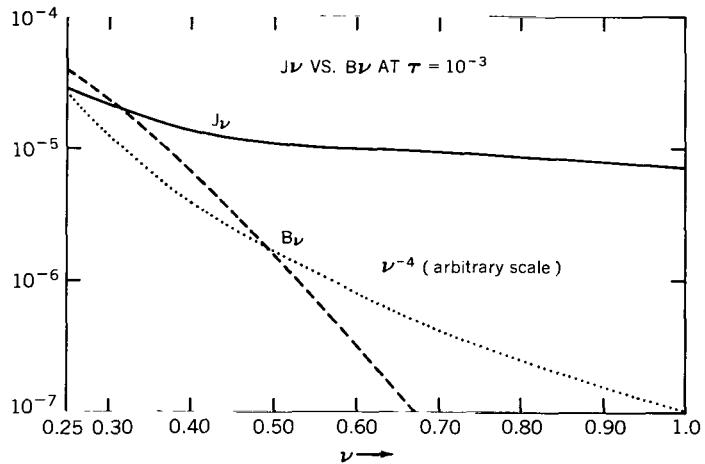


Figure 27— J_ν / B_ν vs. ν at $\tau = 10^{-3}$ ($0.25 \leq \nu \leq 1.00$).

It is convenient to use the notation

$$N_i^* = \frac{N_i}{N_i^{(\circ)}} , \quad \epsilon_\nu^* = \frac{\epsilon_\nu}{\epsilon_\nu^{(\circ)}} , \dots$$

where the superscript (\circ) denotes an equilibrium value. Then

$$\epsilon_\nu = \epsilon_\nu^* \epsilon_\nu^{(\circ)} = \frac{N_j^* N_j^{(\circ)} A_{ji} h R \nu}{4\pi} , \quad (144)$$

and

$$\epsilon_\nu^* = N_j^* , \quad (145)$$

$$K_\nu = K_\nu^* K_\nu^{(\circ)} = \frac{N_i^* N_i^{(\circ)} B_{ij} \left(1 - \frac{N_j^*}{N_i^*} e^{-u}\right) h R \nu}{4\pi} \quad (146)$$

where

$$\frac{N_j^{(\circ)}}{N_i^{(\circ)}} = e^{-u} ,$$

Since

$$k_\nu^{(\circ)} = \frac{N_i^{(\circ)} B_{ij} (1 - e^{-u}) h R \nu}{4\pi} ,$$

$$K_\nu^* = N_i^* \left(1 - \frac{N_j^*}{N_i^*} e^{-u}\right) (1 - e^{-u})^{-1} \quad (147)$$

$$S_\nu = S_\nu^* B_\nu , \quad (148)$$

$$S_\nu^* = \frac{\epsilon_\nu^*}{K_\nu^*} = \frac{N_j^*}{N_i^*} \frac{(1 - e^{-u})}{\left(1 - \frac{N_j^*}{N_i^*} e^{-u}\right)} \quad (149)$$

For a transition to the continuum, the ratio N_j^* for the upper bound state is replaced by the ratio N_e^{*2} for the continuum state. When more than one transition occur at the same frequency, the emission and absorption coefficients are just the sum of the separate contributions. The total source function, however, is not additive, and must be taken as the ratio of the total emission to the total absorption coefficient.

Note that at the line frequencies, the line makes the dominant contribution to the total source function.

Figure 28 shows the steady state source function at $\tau = 10^{-10}$. In the absence of LTE the source function need not be any longer a smooth function of frequency. In the present case it contains absorption edges, absorption lines and even an emission line at $\nu = 0.75$ (Lyman α). The latter arises as follows. At $\nu = 0.75$, we can neglect e^{-u} with respect to 1, and the line source

function is

$$S_\nu = S_\nu^* B_\nu \approx \frac{N_2^*}{N_1^*} B_\nu .$$

At $\tau = 10^{-10}$, Lyman α is already opaque and $N_2^* = N_1^*$, so the line source function equals the Planck function. In the surrounding Balmer continuum, considering only the contribution from the Balmer transition, the source function is

$$S_\nu = S_\nu^* B_\nu = \frac{N_e^{*2}}{N_2^*} B_\nu .$$

$N_e^* = 1$, but $N_2^* > 1$ so the continuum source function falls below the Planck function. Thus, in the source function, Lyman α appears in emission. The other features of the steady state source function can be explained in a similar way.

The emergent continuous flux was integrated with the corrected absorption coefficients and source functions. Since at the level of origin of the Balmer and higher continua, the populations were in LTE, the emergent flux in these continua reproduced the LTE calculation (to within a fraction of a percent). This was not so for the Lyman continuum and the lines. Figure 29 shows the correction to the emergent flux in the Lyman continuum, and Figure 30 shows the corrections to the emergent flux in the center of the lines originating from the first 5 states. The ratio (F_ν^*) of the non-LTE emergent flux to the LTE emergent flux at the centers of the lines connecting the first 10 states is given in Table 13. Since, in the lines, the source function is depressed from the Planck function, the flux — being an integration over the source function — is less than the LTE flux.

Our conclusions pertaining to the atmosphere of an AO star may be summarized as follows:

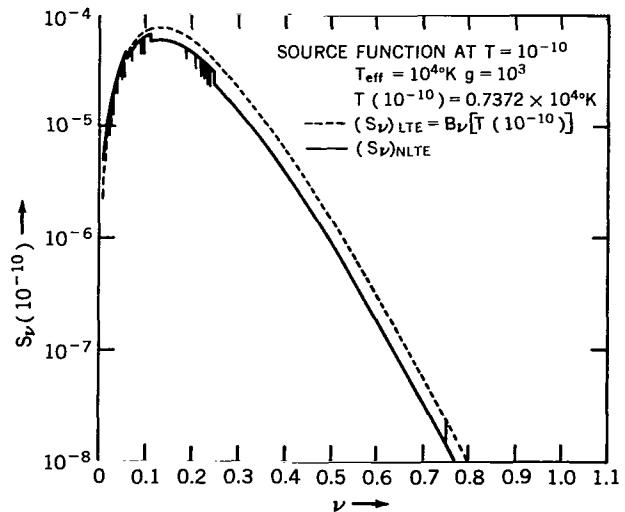


Figure 28—Non-LTE source function at $\tau = 10^{-10}$.

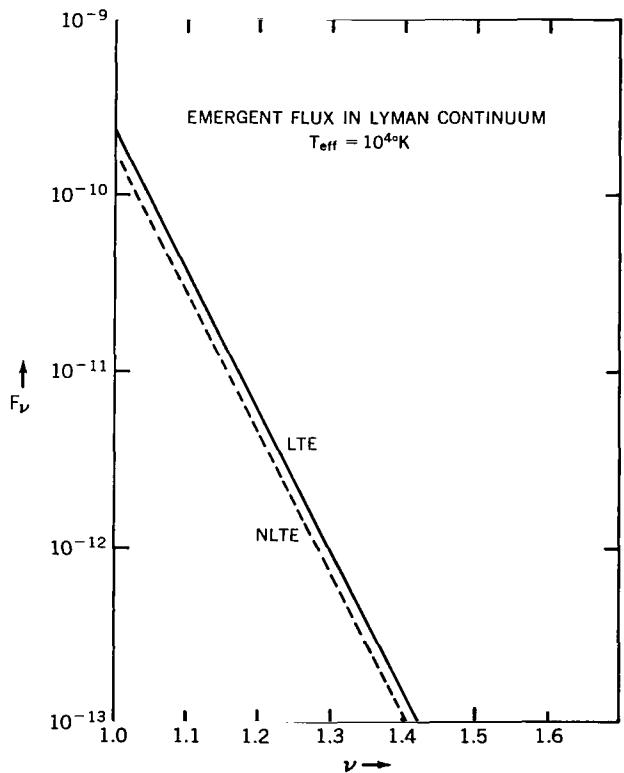


Figure 29—Non-LTE and LTE emergent flux in Lyman continuum.

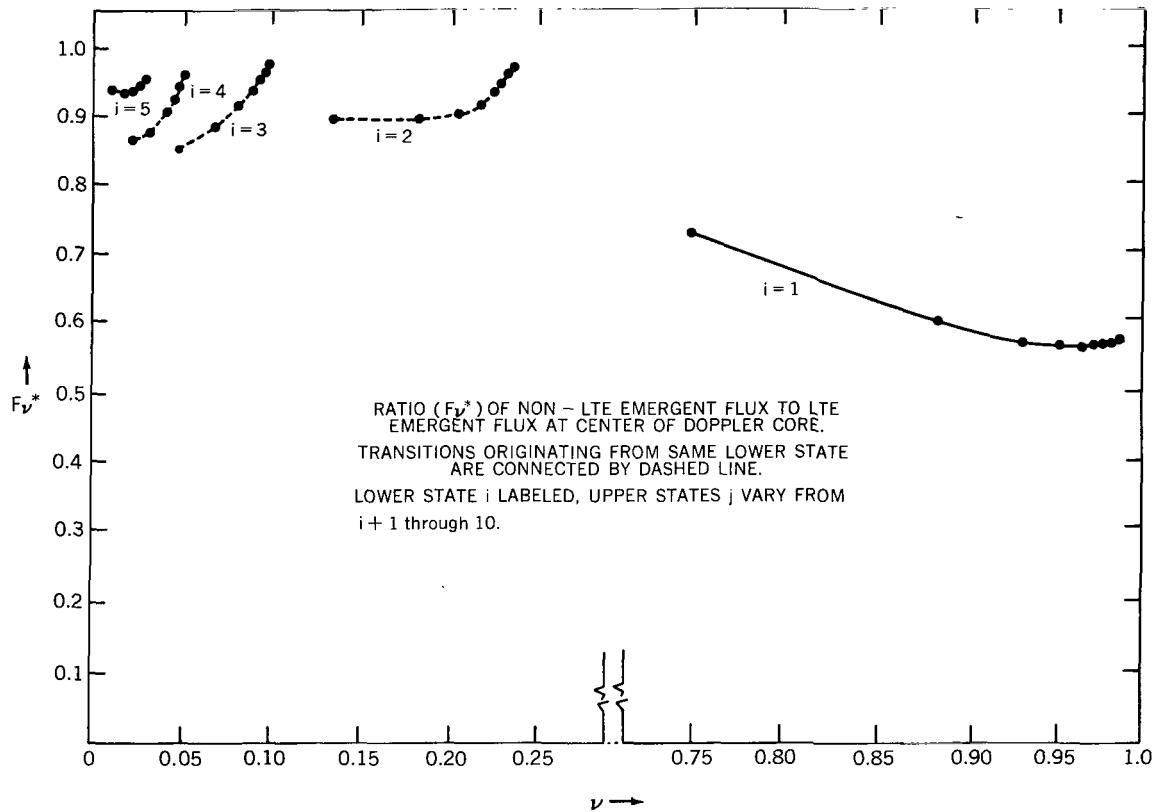


Figure 30—Ratio (F_{ν}^*) of non-LTE to LTE emergent flux in center of lines connecting the first 10 states.

1. For the purpose of calculating the emergent continuous flux and the run of temperature with τ , the atmosphere may be assumed in LTE. Errors introduced by this assumption are less than 1 percent.
2. At the level of origin of the lines, the populations are not in LTE.
 - a. The degree of ionization is approximately one-half that in LTE.
 - b. The lower bound states are overpopulated and the upper bound states are underpopulated with respect to the LTE populations.
 - c. The use of LTE results in overestimating the emergent flux in the lines by 10-30 percent.
3. To calculate the steady state populations of atomic hydrogen in an AO star atmosphere to an accuracy of 1 percent.
 - a. Six bound states are sufficient.
 - b. Collisional rates are of minor importance and collision cross-sections need not be known to within a factor of 10.

One of the purposes of the present study was to evaluate the possible effects of departures from LTE on the temperature structure of the atmosphere. For the AO star, this effect turned

out to be negligible. It is interesting to conjecture whether this effect could be of importance for stars of a different spectral class. Note that in order to change the temperature structure, the departures from LTE must change the opacity in the frequencies carrying the bulk of the flux.

In stars of earlier spectral type, line blanketing is negligible, and we must look to the effects of departures from LTE on the continuous opacity. Near the surface of an early B or O star, electron scattering amounts to about one-half of the continuous opacity. Since the neutral population is small compared to the electron population, the dominant non-LTE effect — over-population of the ground state — will not change this source of opacity. The other major source of opacity, in addition to atomic hydrogen, is atomic helium. Since, in atomic helium, the line opacity and continuous opacity in the resonance continuum are much stronger than the continuous opacity in the higher continua, we expect the populations to be in LTE at the optical depth where the bulk of the continuous flux is formed. Thus, we do not anticipate non-LTE effects on the temperature structure of O and B stars.

In the case of later A, F, and G stars, H⁻ is the dominant source of continuous opacity. Pagel (References 9 and 10) has pointed out that H⁻ is expected to be in LTE. Consequently, for these stars, we can probably neglect non-LTE effects on the temperature structure.

The situation may be different for K and M stars where line blanketing makes a significant contribution to the opacity.

Table 13

Ratio (F_{ν}^*) of Non-LTE Emergent Flux to LTE Emergent Flux at Center of Doppler Core.

i	i	ν_{ii}	$F_{\nu_{ii}}^*$	i	i	ν_{ii}	$F_{\nu_{ii}}^*$
1	2	0.7500	0.722	4	5	0.02250	0.866
	3	0.8889	0.594		6	0.03472	0.878
	4	0.9375	0.563		7	0.04209	0.905
	5	0.9600	0.555		8	0.04688	0.928
	6	0.9722	0.560		9	0.05015	0.944
	7	0.9796	0.560		10	0.05250	0.954
	8	0.9844	0.561	5	6	0.01222	0.940
	9	0.9877	0.562		7	0.01959	0.935
	10	0.9900	0.565		8	0.02437	0.936
	2	0.1389	0.892		9	0.02765	0.944
2	4	0.1875	0.890		10	0.03000	0.953
	5	0.2100	0.894	6	7	0.007370	0.993
	6	0.2222	0.910		8	0.01215	0.989
	7	0.2296	0.926		9	0.01543	0.972
	8	0.2344	0.939		10	0.01778	0.969
	9	0.2377	0.950	7	8	0.004783	1.049
	10	0.2400	0.959		9	0.008062	1.037
	3	0.04861	0.855		10	0.01041	1.007
	5	0.07111	0.882	8	9	0.003279	1.062
	6	0.08333	0.916		10	0.005625	1.049
	7	0.09070	0.937	9	10	0.002346	1.042
	8	0.09549	0.952				
	9	0.09877	0.962				
	10	0.10111	0.969				

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Appendix A

Numerical Techniques

The bulk of the numerical work is required in the evaluation of the Lambda and Phi operators (i.e., the integrations with respect to optical depth in the calculation of $J_\nu(\tau)$ and $F_\nu(\tau)$, and in the integrations with respect to frequency in the calculation of $F(\tau)$, $dF(\tau)/d\tau$ and the dilution factors $w_{ij}(\tau)$ and $w_{ik}(\tau)$.

Part 1 of this appendix treats the τ -integrations and part 2 the ν -integrations.

Integrations with Respect to Optical Depth

The problem is to numerically evaluate the Lambda and Phi operators (Equations 12 and 13 or Chapter 2), given the source function at discrete points in τ . Since the numerical techniques for both operators are similar, we limit the discussion to the Lambda operator.

If we suppress the ν -index and set $t_\nu \equiv x$, $\tau_\nu \equiv t$, Equation 12 can be written

$$J(t) = \frac{1}{2} \int_0^t S(x) E_1(t-x) dx + \frac{1}{2} \int_0^\infty S(x) E_1(x-t) dx . \quad (A1)$$

One integration by parts yields

$$\begin{aligned} J(t) &= S(t) - \frac{1}{2} S(0) - \frac{1}{2} \int_0^t S'(x) E_2(t-x) dx \\ &\quad + \frac{1}{2} \int_t^\infty S'(x) E_2(x-t) dx , \end{aligned} \quad (A2)$$

where

$$S'(x) \equiv \frac{d}{dx} S(x) .$$

Let $S(x)$ be given at a discrete set of points x_i , $i = 1, 2, \dots, N$,

$$\begin{aligned} x_1 &= 0 , \quad x_n = t , \\ \Delta x_i &= x_{i+1} - x_i , \\ S_i &= S(x_i) , \\ S'_i &= (S_{i+1} - S_i) / \Delta x_i^{-1} . \end{aligned}$$

The numerical integration rests on the approximation $S_i' = \text{constant}$ in Δx_i . With this approximation we write Equation A2 as

$$\begin{aligned}
 J(x_n) &= S(x_n) - \frac{1}{2} S(x_1) \\
 &\quad - \frac{1}{2} \sum_{i=1}^{n-1} S_i' [E_3(x_n - x_{i+1}) - E_3(x_n - x_i)] \\
 &\quad + \frac{1}{2} \sum_{i=n}^{N-1} S_i' [E_3(x_i - x_n) - E_3(x_{i+1} - x_n)] \\
 &\quad + S_{N-1}' E_3(x_N - x_n), \tag{A3}
 \end{aligned}$$

except, when $\Delta x_i < 10^{-7}$, the square brackets are replaced by

$$[E_3(x_n - x_{i+1}) - E_3(x_n - x_i)] \rightarrow -E_4(x_n - x_{i+1}) \cdot \Delta x_i, \tag{A4}$$

$$[E_3(x_i - x_n) - E_3(x_{i+1} - x_n)] \rightarrow E_4(x_i - x_n) \cdot \Delta x_i. \tag{A5}$$

The $E_n(x)$ are obtained from $E_1(x)$ by the recursion formulae.* $E_1(x)$ is calculated from the series expansion for $x \leq 1$,* or from the rational approximation developed by Hastings when $x > 1$.† A test of round-off error and the accuracy of the evaluation of the $E_n(x)$ was obtained by integrating a linear function. The difference between the numerical integration and an analytic integration was less than 1 part in 10^7 .

For an arbitrary source function, the accuracy depends on the distribution of τ -points. The grey atmosphere was integrated monochromatically using the same set of 68 τ -points as was used in the non-grey integrations. The integrated flux in the grey atmosphere was accurate to 2 parts in 10^4 .

Integrations with Respect to Frequency

Different numerical procedures were used to integrate over the continuum and to integrate over the lines.

INTEGRATIONS OVER THE CONTINUUM

The frequency dependent function to be integrated was assumed smooth between absorption edges. If there were 7 or more frequencies between 2 absorption edges, Weddle's rule was used,‡

*Kourganoff, V. "Basic Methods in Transfer Problems; Radiative Equilibrium and Neutron Diffusion," Oxford: Clarendon Press, 1952.

†Hastings, C., Jr., "Approximations for Digital Computers," Princeton, New Jersey: Princeton Univ. Press, 1955.

‡Kopal, Z., "Numerical Analysis," New York: John Wiley, 1961.

while if there were less than 7 frequencies, Simpson's rule was used. Between 2 absorption edges, the frequencies were equally spaced. The number of frequencies used in the integrations of W_{ik} , the non-grey atmosphere and the monochromatic grey atmosphere is listed below.

The frequencies used in the W_{ik} integration were chosen to insure an accuracy of 1 part in 10^3 in the integration over each continuum. This was tested by integrating the function $[U(e^U - 1)]^{-1}$ which is representative of the W_{ik} integrand. The analytic integral of this function is

Continuum	W_{ik}	Non-Grey	Grey Monochromatic
$1 \rightarrow \infty$	19	1	7 1.0 (0.5) 4.0
$2 \rightarrow 1$	25	19	19
$3 \rightarrow 2$	13	19	19
$4 \rightarrow 3$	5	7	7
$5 \rightarrow 4$	5	7	7
$6 \rightarrow 5$	3	5	5
$7 \rightarrow 6$	3	3	3
$8 \rightarrow 7$	3	3	3
$9 \rightarrow 8$	3	3	3
$10 \rightarrow 9$	3	3	3
	82	70	76

$$\int_{\delta}^{\infty} \frac{dU}{U} \frac{1}{e^U - 1} = \sum_{n=1}^{\infty} E_1(n\delta) . \quad (A6)$$

When $\delta < 1$, the following formulae are used:

$$\int_{\delta}^{\infty} \frac{dU}{U} \frac{1}{e^U - 1} = \int_{\delta}^1 \frac{dU}{U} \frac{1}{e^U - 1} + \sum_{n=1}^{\infty} E_1(n) , \quad (A7)$$

$$\begin{aligned} \int_{\delta}^1 \frac{dU}{U} \frac{1}{e^U - 1} &= \frac{1 - \delta}{\delta} + \frac{1}{2} \ln \delta + \frac{B_1}{2 \cdot 2!} (1 - \delta^2) \\ &\quad - \frac{B_2}{4 \cdot 4!} (1 - \delta^4) + \frac{B_3}{6 \cdot 6!} (1 - \delta^6) - \dots , \end{aligned} \quad (A8)$$

where B_n are the Bernoulli numbers.*

In the non-grey and monochromatic grey programs the frequencies were distributed according to the relative magnitude of the monochromatic fluxes. In the non-grey program, the frequencies beyond the Lyman limit were dropped.

INTEGRATION OVER THE LINES (W_{ij})

To evaluate W_{ij} , a 5 point Gauss-Hermite quadrature† was used for the transitions connecting the first 5 states. For the remainder of the transitions, only the central intensities were used.

*Dwight, H. B., "Tables of Integrals and Other Mathematical Data," (revised edition) New York: Macmillan, 1947.

†Kopal, Z., "Numerical Analysis," New York: John Wiley, 1961 .

The quadrature program selects the 5 values of the dimensionless integration variable $x = \frac{\nu - \nu_{ij}}{\Delta_{ij}(T)}$. The corresponding frequencies were selected using $\Delta_{ij}(T)$ evaluated for the boundary temperature. J_ν and B_ν were tabulated at only these frequencies. Since x is fixed, as the temperature increased, J_ν and B_ν were required at slightly different frequencies, and thus had to be interpolated. However, because $\Delta_{ij}(T)$ varies only as the square root of T , the frequency shift was small and linear interpolation was adequate.

Appendix B

Numerical Results for the Grey Atmosphere

This appendix contains numerical results for the Grey Atmosphere tabulated at 280 τ 's equally spaced in $\log \tau$. The notation used in the column heading is explained below.

1. TAU = τ
2. B LAST = normalized source function (called b in the text). 1.0 - FLUX, Q(TAU), etc. refer to B LAST
3. CHANGE = δb called for by the iteration routine
4. B NEXT = B LAST + CHANGE
5. 1.0 - FLUX = 1.0 - normalized flux (called 1-f in text).
6. Q(TAU) = defined from $b = \frac{3}{4} [\tau + Q(\tau)]$
7. TEMPERATURE = $T(\tau)/T_{eff}$.
8. DFLUX/DTAU = derivative of normalized flux with respect to τ . (called df/d τ in the text)
9. LOG(TAU) = $\log (\tau)$

TAU	B LAST	CHANGE	B NEXT	I.O-FLUX	Q(TAU)	TEMPERATURE	OFLUX/DATAU	LOG(TAU)
0.	0.43301351	-0.00000028	0.43301324	0.00000802	0.57735098	0.81119505	-0.00001712	-5.02499998
0.000010	0.43304396	-0.00000028	0.43304368	0.00000803	0.57738157	0.81120931	-0.00001717	-5.00000000
0.000011	0.43304566	-0.00000028	0.43304537	0.00000807	0.57738324	0.81121010	-0.00001717	-4.97499996
0.000012	0.43304928	-0.00000028	0.43304899	0.00000802	0.57738677	0.81121179	-0.00001715	-4.92499995
0.000013	0.43305125	-0.00000029	0.43305096	0.00000806	0.57738868	0.81121271	-0.00001718	-4.89999998
0.000014	0.43305332	-0.00000030	0.43305302	0.00000805	0.57739069	0.81121369	-0.00001721	-4.87500000
0.000015	0.43305549	-0.00000029	0.43305519	0.00000803	0.57739279	0.81121471	-0.00001720	-4.84999996
0.000016	0.43305777	-0.00000026	0.43305751	0.00000799	0.57739504	0.81121577	-0.00001708	-4.82499999
0.000017	0.43306277	-0.00000028	0.43306248	0.00000802	0.57739738	0.81121691	-0.00001717	-4.79999995
0.000018	0.43306544	-0.00000028	0.43306517	0.00000802	0.57740244	0.81121937	-0.00001712	-4.75000000
0.000019	0.43306831	-0.00000028	0.43306802	0.00000801	0.57740518	0.81122071	-0.00001715	-4.72499996
0.000020	0.43307131	-0.00000028	0.43307103	0.00000808	0.57740808	0.81122211	-0.00001714	-4.69999999
0.000021	0.43307444	-0.00000027	0.43307418	0.00000802	0.57741110	0.81122359	-0.00001709	-4.67499995
0.000022	0.43307783	-0.00000031	0.43307752	0.00000803	0.57741430	0.81122515	-0.00001724	-4.64999998
0.000024	0.43308132	-0.00000030	0.43308102	0.00000802	0.57741764	0.81122679	-0.00001723	-4.62500000
0.000025	0.43308502	-0.00000028	0.43308474	0.00000803	0.57742120	0.81122854	-0.00001715	-4.59999996
0.000027	0.43308893	-0.00000028	0.43308865	0.00000803	0.57742492	0.81123037	-0.00001714	-4.57499999
0.000028	0.43309305	-0.00000029	0.43309276	0.00000805	0.57742883	0.81123229	-0.00001718	-4.54999995
0.000030	0.43309739	-0.00000029	0.43309710	0.00000802	0.57743295	0.81123432	-0.00001718	-4.52499998
0.000032	0.43310197	-0.00000029	0.43310168	0.00000799	0.57743727	0.81123646	-0.00001718	-4.50000000
0.000033	0.43310679	-0.00000027	0.43310652	0.00000805	0.57744186	0.81123874	-0.00001711	-4.47499996
0.000035	0.43311188	-0.00000031	0.43311157	0.00000802	0.57744660	0.81124110	-0.00001729	-4.44999999
0.000038	0.43311723	-0.00000028	0.43311694	0.00000801	0.57745167	0.81124362	-0.00001717	-4.42499995
0.000040	0.43312290	-0.00000028	0.43312263	0.00000802	0.57745702	0.81124628	-0.00001712	-4.39999998
0.000042	0.43312886	-0.00000031	0.43312855	0.00000800	0.57746256	0.81124904	-0.00001726	-4.37500000
0.000045	0.43313511	-0.00000028	0.43313482	0.00000803	0.57746843	0.81125199	-0.00001717	-4.34999996
0.000047	0.43314173	-0.00000028	0.43314145	0.00000806	0.57747461	0.81125509	-0.00001715	-4.32499999
0.000050	0.43314871	-0.00000029	0.43314841	0.00000805	0.57748110	0.81125835	-0.00001720	-4.29999995
0.000053	0.43315607	-0.00000028	0.43315578	0.00000799	0.57748794	0.81126180	-0.00001717	-4.27499998
0.000056	0.43316381	-0.00000028	0.43316352	0.00000804	0.57749513	0.81126543	-0.00001715	-4.25000000
0.000060	0.43317197	-0.00000028	0.43317168	0.00000803	0.57750268	0.81126925	-0.00001717	-4.22499996
0.000063	0.43318057	-0.00000027	0.43318029	0.00000804	0.57751063	0.81127328	-0.00001711	-4.19999999
0.000067	0.43318965	-0.00000029	0.43318936	0.00000802	0.57751897	0.81127752	-0.00001718	-4.17499995
0.000071	0.433191920	-0.00000028	0.433119892	0.00000800	0.57752777	0.81128200	-0.00001715	-4.14999998
0.000075	0.43320928	-0.00000028	0.43320899	0.00000805	0.57753700	0.81128671	-0.00001714	-4.12500000
0.000079	0.43321991	-0.00000030	0.43321960	0.00000802	0.57754670	0.81129169	-0.00001723	-4.09999996
0.000084	0.43323108	-0.00000029	0.43323079	0.00000805	0.57755690	0.81129692	-0.00001718	-4.07499999
0.000089	0.43324287	-0.00000031	0.43324256	0.00000802	0.57756761	0.81130243	-0.00001727	-4.04999995
0.000094	0.43325256	-0.00000029	0.433252496	0.00000801	0.57757887	0.81130823	-0.00001718	-4.02499998
0.000100	0.43326834	-0.00000028	0.43326806	0.00000806	0.57759074	0.81131437	-0.00001715	-4.00000000
0.000106	0.43328209	-0.00000028	0.43328182	0.00000803	0.57760315	0.81132080	-0.00001714	-3.97499999
0.000112	0.43329663	-0.00000028	0.43329635	0.00000802	0.57761625	0.81132761	-0.00001714	-3.95000002
0.000119	0.43331192	-0.00000028	0.43331165	0.00000802	0.57763001	0.81133477	-0.00001714	-3.92500001
0.000126	0.43332807	-0.00000029	0.43332777	0.00000802	0.57764446	0.81134232	-0.00001720	-3.90000001
0.000133	0.43334503	-0.00000026	0.43334477	0.00000802	0.57765966	0.81135027	-0.00001708	-3.87500000
0.000141	0.43336293	-0.00000028	0.43336265	0.00000804	0.57767561	0.81135865	-0.00001714	-3.84999999
0.000150	0.43338176	-0.00000029	0.43338147	0.00000802	0.57769232	0.81136744	-0.00001718	-3.82500002
0.000158	0.43340161	-0.00000030	0.43340131	0.00000802	0.57770991	0.81137674	-0.00001721	-3.80000001
0.000168	0.43342248	-0.00000026	0.43342222	0.00000801	0.57772841	0.81138653	-0.00001708	-3.77500001
0.000178	0.43344453	-0.00000028	0.43344425	0.00000801	0.57774783	0.81139683	-0.00001717	-3.75000000
0.000188	0.43346775	-0.00000032	0.43346742	0.00000803	0.57776819	0.81140768	-0.00001732	-3.72499999
0.000200	0.43349215	-0.00000028	0.43349187	0.00000802	0.57778963	0.81141912	-0.00001712	-3.70000002
0.000211	0.43351792	-0.00000028	0.43351763	0.00000802	0.57781215	0.81143118	-0.00001717	-3.67500001
0.000224	0.433534502	-0.00000028	0.433534473	0.00000806	0.57783576	0.81144386	-0.00001717	-3.65000001
0.000237	0.43357356	-0.00000030	0.43357326	0.00000799	0.57786053	0.81145720	-0.00001723	-3.62500000
0.000251	0.43360364	-0.00000031	0.43360333	0.00000803	0.57788658	0.81147128	-0.00001726	-3.59999999
0.000266	0.43363531	-0.00000032	0.43363499	0.00000802	0.57791390	0.81148609	-0.00001732	-3.57500002
0.000282	0.43366864	-0.00000030	0.43366834	0.00000797	0.57794261	0.81150169	-0.00001721	-3.55000001
0.000299	0.43370374	-0.00000028	0.43370344	0.00000800	0.57797272	0.81151810	-0.00001717	-3.52500001
0.000316	0.43374070	-0.00000026	0.43374044	0.00000799	0.57800435	0.81153542	-0.00001708	-3.50000000
0.000335	0.43377966	-0.00000030	0.43377936	0.00000803	0.57803750	0.81155361	-0.00001723	-3.47499999
0.000355	0.43382066	-0.00000031	0.43382036	0.00000802	0.57807232	0.81157279	-0.00001724	-3.45000002
0.000376	0.43386380	-0.00000030	0.43386350	0.00000804	0.57810882	0.81159296	-0.00001721	-3.42500001
0.000398	0.43390923	-0.00000031	0.43390892	0.00000799	0.57814711	0.81161422	-0.00001726	-3.40000001
0.000422	0.43395713	-0.00000031	0.43395682	0.00000802	0.57818738	0.81163662	-0.00001727	-3.37500000
0.000447	0.43404747	-0.00000027	0.43404719	0.00000806	0.57822957	0.81166016	-0.00001711	-3.34999999
0.000473	0.43406050	-0.00000028	0.43406022	0.00000800	0.57827380	0.81168495	-0.00001715	-3.32500002
0.000501	0.43411632	-0.00000029	0.43411603	0.00000804	0.57832018	0.81171104	-0.00001720	-3.30000001
0.000531	0.43417599	-0.00000028	0.43417481	0.00000803	0.57836884	0.81173851	-0.00001715	-3.27500001
0.000562	0.43423694	-0.00000029	0.43423665	0.00000808	0.57841985	0.81176742	-0.00001718	-3.25000000

0.C00596	0.43430205	-0.CC0C0031	0.43430173	0.00000802	0.57847331	0.81179783	-0.00001727	-3.22499999
0.C00631	0.43437058	-0.CC000028	0.43437030	0.00000802	0.57852944	0.81182987	-0.00001717	-3.20000002
0.000668	0.43444273	-0.CC0C0028	0.43444245	0.00000800	0.57858825	0.81186359	-0.00001715	-3.17500001
0.000708	0.43451868	-0.00000030	0.43451838	0.00000808	0.57864989	0.81189906	-0.00001723	-3.12500000
0.000750	0.43459859	-0.00000030	0.43459829	0.00000807	0.57871448	0.81193638	-0.00001723	-3.12500000
0.000794	0.43468270	-0.00000031	0.43468238	0.00000799	0.57878219	0.81197565	-0.00001729	-3.09999999
0.000841	0.43477120	-0.00000031	0.43477088	0.00000801	0.57885310	0.81201698	-0.00001730	-3.07500002
0.000891	0.43486432	-0.00000028	0.43486404	0.00000801	0.57892746	0.81206047	-0.00001717	-3.05000001
0.000944	0.43496235	-0.00000030	0.43496206	0.00000806	0.57900534	0.81210623	-0.00001723	-3.02500001
0.001000	0.43506549	-0.00000030	0.43506519	0.00000803	0.57908691	0.81215436	-0.00001724	-3.00000000
0.001059	0.43517398	-0.00000030	0.43517368	0.00000805	0.57917231	0.81220499	-0.00001724	-2.97500002
0.001122	0.43528817	-0.00000031	0.43528786	0.00000802	0.57926179	0.81225827	-0.00001726	-2.95000002
0.001189	0.43540829	-0.00000028	0.43540800	0.00000799	0.57935549	0.81231430	-0.00001718	-2.92500001
0.001259	0.43553471	-0.00000028	0.43553442	0.00000805	0.57945362	0.81237326	-0.00001720	-2.90000004
0.001334	0.43566765	-0.00000028	0.43566737	0.00000803	0.57955630	0.81243526	-0.00001715	-2.87500003
0.001413	0.43580755	-0.00000028	0.43580726	0.00000805	0.57966381	0.81250045	-0.00001720	-2.85000002
0.001496	0.43595470	-0.00000030	0.43595440	0.00000807	0.57977629	0.81256902	-0.00001724	-2.82500002
0.001585	0.43610948	-0.00000029	0.43610919	0.00000803	0.57989402	0.81264114	-0.00001721	-2.80000001
0.001679	0.43627231	-0.00000031	0.43627200	0.00000799	0.58001719	0.81271698	-0.00001727	-2.77500004
0.001778	0.43644357	-0.00000029	0.43644327	0.00000808	0.58014607	0.81279673	-0.00001723	-2.75000003
0.001884	0.43662370	-0.00000030	0.43662340	0.00000805	0.58028088	0.81288058	-0.00001726	-2.72500002
0.001995	0.43681313	-0.00000028	0.43681285	0.00000806	0.58042186	0.81296875	-0.00001720	-2.70000002
0.002113	0.43701239	-0.00000028	0.43701211	0.00000809	0.58056931	0.81306144	-0.00001721	-2.67500001
0.002239	0.43722194	-0.00000030	0.43722164	0.00000807	0.58072345	0.81315888	-0.00001727	-2.65000004
0.002371	0.43744228	-0.CC0C0028	0.43744200	0.00000810	0.58088461	0.81326132	-0.00001721	-2.62500003
0.002512	0.43767401	-0.00000028	0.43767373	0.00000802	0.58105308	0.81336900	-0.00001721	-2.60000002
0.002661	0.43791769	-0.00000031	0.43791738	0.00000814	0.58122911	0.81348217	-0.00001734	-2.57500002
0.002818	0.43817386	-0.00000031	0.43817355	0.00000808	0.58141301	0.81360111	-0.00001733	-2.55000001
0.002985	0.43844327	-0.00000031	0.43844295	0.00000809	0.58160521	0.81372616	-0.00001734	-2.52500004
0.003162	0.43872648	-0.00000030	0.43872618	0.00000807	0.58180595	0.81385753	-0.00001729	-2.50000003
0.003350	0.43926243	-0.00000028	0.43902394	0.00000806	0.58201560	0.81399558	-0.00001724	-2.47500002
0.003548	0.43933725	-0.00000031	0.43933694	0.00000807	0.58223445	0.81414063	-0.00001733	-2.45000002
0.003758	0.43966634	-0.00000031	0.43966602	0.00000807	0.58246298	0.81429305	-0.00001737	-2.42500001
0.003981	0.44001227	-0.00000033	0.44001194	0.00000807	0.58270150	0.81445316	-0.00001742	-2.40000004
0.004217	0.44037590	-0.00000031	0.44037558	0.00000813	0.58295047	0.81462138	-0.00001737	-2.37500003
0.004467	0.44075812	-0.00000029	0.44075783	0.00000810	0.58321026	0.81479809	-0.00001730	-2.35000002
0.004732	0.441115984	-0.00000031	0.441115959	0.00000809	0.58348118	0.81498369	-0.00001739	-2.32500002
0.005012	0.44158207	-0.00000030	0.44158177	0.00000804	0.58376381	0.81517863	-0.00001733	-2.30000001
0.005309	0.44202583	-0.00000033	0.44202550	0.00000812	0.58405847	0.81538333	-0.00001745	-2.27500004
0.005623	0.44249219	-0.00000031	0.44249189	0.00000810	0.58436577	0.81559832	-0.00001737	-2.25000003
0.005957	0.44298230	-0.00000034	0.44298197	0.00000806	0.58468600	0.81582406	-0.00001749	-2.22500002
0.006310	0.44349729	-0.00000031	0.44349698	0.00000808	0.58501973	0.81606108	-0.00001739	-2.20000002
0.006683	0.44403848	-0.00000031	0.44403816	0.00000812	0.58536743	0.81630991	-0.00001743	-2.17500001
0.007079	0.44460711	-0.00000031	0.44460679	0.00000816	0.58572959	0.81657112	-0.00001745	-2.15000004
0.007499	0.44520458	-0.00000031	0.44520427	0.00000812	0.58610674	0.81684533	-0.00001745	-2.12500003
0.007943	0.44583234	-0.00000033	0.44583201	0.00000814	0.58649940	0.81713313	-0.00001752	-2.10000002
0.008414	0.44649193	-0.00000036	0.44649157	0.00000816	0.58690013	0.81743516	-0.00001764	-2.07500002
0.008913	0.44718481	-0.00000032	0.44718449	0.00000814	0.58733347	0.81775213	-0.00001752	-2.05000001
0.009441	0.44791275	-0.00000034	0.44791251	0.00000814	0.58777593	0.81808469	-0.00001761	-2.02500004
0.010000	0.44867744	-0.00000032	0.44867712	0.00000817	0.58823615	0.81843366	-0.00001755	-2.00000003
0.010593	0.44948073	-0.00000034	0.44948038	0.00000817	0.58871464	0.81879973	-0.00001766	-1.97500002
0.011220	0.45032455	-0.00000036	0.45032419	0.00000824	0.58921207	0.81918374	-0.00001772	-1.95000002
0.011885	0.45121083	-0.00000032	0.45121051	0.00000816	0.58972898	0.81958650	-0.00001758	-1.92500001
0.012589	0.45214177	-0.00000034	0.45214143	0.00000825	0.59026598	0.82000891	-0.00001766	-1.90000004
0.013335	0.45311948	-0.00000033	0.45311915	0.00000817	0.59082365	0.82045186	-0.00001766	-1.87500003
0.014125	0.45414638	-0.00000034	0.45414604	0.00000822	0.59140267	0.82091630	-0.00001773	-1.85000002
0.014962	0.45522492	-0.00000037	0.45522455	0.00000822	0.59200370	0.82140325	-0.00001788	-1.82500002
0.015849	0.45635761	-0.00000036	0.45635726	0.00000823	0.59262740	0.82191374	-0.00001785	-1.80000001
0.016788	0.45754712	-0.00000037	0.45754675	0.00000823	0.59327429	0.82244880	-0.00001791	-1.77500004
0.017783	0.45879628	-0.00000030	0.45879597	0.00000829	0.59394516	0.82300095	-0.00001766	-1.75000003
0.018836	0.46010811	-0.00000041	0.46010770	0.00000826	0.59464043	0.82359723	-0.00001812	-1.72500002
0.019953	0.46148559	-0.00000037	0.46148521	0.00000829	0.59536099	0.82421298	-0.00001802	-1.70000002
0.021135	0.46293202	-0.00000036	0.46293166	0.00000828	0.59610731	0.82485805	-0.00001799	-1.67500004
0.022387	0.46445087	-0.00000036	0.46445050	0.00000828	0.59688012	0.82553380	-0.00001802	-1.65000004
0.023714	0.46604570	-0.00000036	0.46604534	0.00000838	0.59768005	0.82624157	-0.00001805	-1.62500003
0.025119	0.46772025	-0.00000037	0.46771988	0.00000832	0.59850764	0.82698276	-0.00001809	-1.60000002

0.026607	0.46947848	-0.00000041	0.46947807	0.00000833	0.59936351	0.82775885	-0.00001831	-1.57500002
0.028184	0.47132456	-0.00000039	0.47132418	0.00000836	0.60024840	0.82857138	-0.00001828	-1.55000004
0.029856	0.47326286	-0.00000042	0.47326244	0.00000837	0.60116276	0.82942194	-0.00001842	-1.52500004
0.031623	0.47529794	-0.00000041	0.47529753	0.00000840	0.60210725	0.83031214	-0.00001843	-1.50000003
0.033497	0.47743463	-0.00000038	0.47743425	0.00000843	0.60308244	0.83124375	-0.00001839	-1.47500002
0.035481	0.47967797	-0.00000040	0.47967757	0.00000843	0.60408874	0.83221848	-0.00001852	-1.45000002
0.037584	0.48203330	-0.00000042	0.48203288	0.00000851	0.60512675	0.83323819	-0.00001864	-1.42500004
0.039811	0.48450618	-0.00000039	0.48450579	0.00000855	0.60619698	0.83430480	-0.00001860	-1.40000004
0.042170	0.48710250	-0.00000044	0.48710205	0.00000849	0.60729975	0.83542024	-0.00001885	-1.37500003
0.044668	0.48982845	-0.00000043	0.48982801	0.00000857	0.60843565	0.83658660	-0.00001886	-1.35000002
0.047315	0.49269050	-0.00000048	0.49269001	0.00000855	0.60960489	0.83780595	-0.00001916	-1.32500002
0.050119	0.49569540	-0.00000044	0.49569497	0.00000860	0.61080790	0.83908049	-0.00001903	-1.30000004
0.053088	0.49885053	-0.00000048	0.49885006	0.00000855	0.61204495	0.84041250	-0.00001927	-1.27500004
0.056234	0.50216318	-0.00000048	0.50216270	0.00000861	0.61331613	0.84180426	-0.00001931	-1.25000003
0.059566	0.50564156	-0.00000051	0.50564104	0.00000867	0.61462183	0.84325822	-0.00001955	-1.22500002
0.063096	0.50929387	-0.00000048	0.50929339	0.00000864	0.61596211	0.84477685	-0.00001949	-1.20000002
0.066834	0.51312903	-0.00000047	0.51312856	0.00000874	0.61733701	0.84636276	-0.00001958	-1.17500004
0.070795	0.51715626	-0.00000051	0.51715574	0.00000868	0.61874640	0.84801851	-0.00001985	-1.15000004
0.074989	0.52138533	-0.00000048	0.52138485	0.00000875	0.62019037	0.84974692	-0.00001985	-1.12500003
0.079433	0.52582662	-0.00000051	0.52582610	0.00000875	0.62166864	0.85155075	-0.00002009	-1.10000002
0.084140	0.53049091	-0.00000051	0.53049041	0.00000881	0.62318102	0.85343291	-0.00002018	-1.07500002
0.089125	0.53538968	-0.00000056	0.53538912	0.00000882	0.62472706	0.85539635	-0.00002053	-1.05000004
0.094406	0.54C53499	-0.00000061	0.54053438	0.00000883	0.62630641	0.85744413	-0.00002086	-1.02500004
0.100000	0.54593955	-0.00000064	0.54593891	0.00000885	0.62791853	0.85957943	-0.00002113	-1.00000003
0.105925	0.55161677	-0.00000060	0.55161616	0.00000885	0.62956282	0.86180548	-0.00002116	-0.97500002
0.112202	0.55758078	-0.00000057	0.55758021	0.00000889	0.63123843	0.86412555	-0.00002119	-0.95000005
0.118850	0.56384672	-0.00000060	0.56384612	0.00000888	0.63294460	0.86654506	-0.00002149	-0.92500007
0.125893	0.57043027	-0.00000061	0.57042966	0.00000890	0.63646803	0.86906153	-0.00002173	-0.90000004
0.133352	0.57734810	-0.00000064	0.57734746	0.00000890	0.63644446	0.87168448	-0.00002205	-0.87500006
0.141254	0.58461777	-0.00000062	0.58461715	0.00000889	0.63823578	0.87415159	-0.00002217	-0.85000002
0.149624	0.59225803	-0.00000060	0.59225743	0.00000891	0.64005301	0.87725859	-0.00002229	-0.82500005
0.158489	0.60028853	-0.00000065	0.60028788	0.00000893	0.64189453	0.88021730	-0.00002274	-0.80000007
0.167880	0.60873010	-0.00000066	0.60872944	0.00000888	0.64375885	0.88329563	-0.00002304	-0.77500004
0.177828	0.61760472	-0.00000063	0.61760409	0.00000885	0.64564419	0.88649755	-0.00002319	-0.75000006
0.188365	0.62693579	-0.00000067	0.62693512	0.00000886	0.64754857	0.88982714	-0.00002363	-0.72500002
0.199526	0.63674754	-0.00000066	0.63674693	0.00000882	0.64946967	0.89328843	-0.00002387	-0.70000005
0.211349	0.64706675	-0.00000061	0.64706614	0.00000876	0.65140596	0.89688585	-0.00002402	-0.67500007
0.223872	0.65792087	-0.00000064	0.65792023	0.00000867	0.65335485	0.90062356	-0.00002447	-0.65000004
0.237137	0.66933910	-0.00000060	0.66933849	0.00000860	0.65531396	0.90450600	-0.00002468	-0.62500006
0.251189	0.68135234	-0.00000057	0.68135177	0.00000855	0.65728038	0.90835747	-0.00002488	-0.60000002
0.266072	0.69359377	-0.00000065	0.69359312	0.00000864	0.65925167	0.91272257	-0.00002560	-0.57500005
0.281838	0.70729796	-0.00000056	0.70729740	0.00000837	0.66122493	0.91706584	-0.00002563	-0.55000007
0.298538	0.72130213	-0.00000049	0.72130164	0.00000821	0.66319726	0.92157191	-0.00002578	-0.52500004
0.316228	0.73664533	-0.00000057	0.73664776	0.00000810	0.66516528	0.92624538	-0.00002652	-0.50000006
0.334965	0.75156919	-0.00000047	0.75156872	0.00000788	0.66712619	0.93109110	-0.00002658	-0.47500002
0.354813	0.76751789	-0.00000046	0.76751742	0.00000766	0.66907652	0.93611377	-0.00002703	-0.45000005
0.375837	0.78513808	-0.00000034	0.78513774	0.00000747	0.67101295	0.94131822	-0.00002700	-0.42500007
0.398107	0.80327977	-0.00000034	0.80327944	0.00000732	0.67293210	0.94670934	-0.00002751	-0.40000004
0.421696	0.82239545	-0.00000033	0.82239512	0.00000706	0.67483036	0.95229200	-0.00002798	-0.37500006
0.446684	0.84254128	-0.00000025	0.84254102	0.00000686	0.67670444	0.95807116	-0.00002822	-0.35000002
0.473151	0.86377659	-0.00000014	0.86377645	0.00000657	0.67855069	0.96405173	-0.00002831	-0.32500005
0.501187	0.88616466	-0.00000011	0.88616455	0.00000634	0.68036557	0.97023869	-0.00002876	-0.30000007
0.530884	0.90977263	-0.00000004	0.90977259	0.00000605	0.68214571	0.97663707	-0.00002906	-0.27500004
0.562341	0.93467154	-0.00000013	0.93467167	0.00000575	0.68388764	0.98325183	-0.00002891	-0.25000006
0.595662	0.96093740	-0.00000019	0.96093759	0.00000543	0.68558799	0.99008801	-0.00002924	-0.22500002
0.630957	0.98865035	-0.00000026	0.98865061	0.00000508	0.68724354	0.99715050	-0.00002953	-0.20000005
0.668344	1.01789571	-0.00000025	1.01789597	0.00000475	0.68885079	1.00444426	-0.00003004	-0.17500007
0.707946	1.04876433	-0.00000034	1.04876468	0.00000437	0.69040716	1.01197435	-0.00003028	-0.15000004
0.749894	1.08135219	0.00000046	1.08135265	0.00000391	0.69190941	1.01974557	-0.00003034	-0.12500006
0.794328	1.11576244	0.00000046	1.11576290	0.00000339	0.69335567	1.02776299	-0.00003082	-0.10000002
0.841395	1.15210332	0.00000075	1.15210406	0.00000280	0.69474369	1.03603143	-0.00003016	-0.07500005
0.891251	1.19049039	0.00000070	1.19049110	0.00000221	0.69607066	1.04455553	-0.00003070	-0.05000007
0.944061	1.23104644	0.00000069	1.23104712	0.00000165	0.69733536	1.05334020	-0.00003105	-0.02500004
1.000000	1.27390118	0.00000075	1.27390192	0.00000107	0.69853602	1.06239004	-0.00003105	-0.00000006
1.059254	1.31919320	0.00000069	1.31919388	0.00000058	0.69967152	1.07170968	-0.00003147	0.02499998
1.122018	1.36706872	0.00000076	1.36706948	0.00000007	0.70074099	1.08130358	-0.00003129	0.04999995

1.188502	1.41768387	0.00000082	1.41768469	-0.00000037	0.70174423	1.09117626	-0.00003105	0.07499993
1.258925	1.47120385	0.00000072	1.47120456	-0.00000079	0.70268078	1.10133201	-0.00003135	0.09999996
1.333521	1.52780370	0.00000079	1.52780449	-0.00000122	0.70355140	1.11177510	-0.00003088	0.12499994
1.412537	1.58766988	0.00000067	1.58767055	-0.00000155	0.70435660	1.12250969	-0.00003015	0.14999998
1.496235	1.65099888	0.00000067	1.65099955	-0.00000177	0.70509726	1.13353969	-0.00003064	0.17499995
1.584893	1.71800044	0.00000048	1.71800092	-0.00000192	0.70577495	1.14486912	-0.00003099	0.19999993
1.678804	1.78889629	0.00000046	1.78889675	-0.00000201	0.70639180	1.15650180	-0.00003052	0.22499996
1.778279	1.86392111	0.00000042	1.86392152	-0.00000186	0.70694956	1.16844131	-0.00003016	0.24999994
1.883649	1.94332445	0.00000021	1.94332466	-0.00000176	0.70745060	1.18069123	-0.00003046	0.27499998
1.995262	2.02736810	0.00000009	2.02736819	-0.00000171	0.70789549	1.19325468	-0.00003040	0.29999995
2.113489	2.11633533	0.00000009	2.11633542	-0.00000182	0.70829192	1.20613557	-0.00002980	0.32499993
2.238721	2.21052125	0.00000006	2.21052131	-0.00000213	0.70864084	1.21933678	-0.00002921	0.34999996
2.371373	2.31023964	-0.00000003	2.31023961	-0.00000222	0.70894617	1.23286140	-0.00002873	0.37499994
2.511886	2.41582209	-0.00000006	2.41582203	-0.00000216	0.70920980	1.24671225	-0.00002801	0.39999998
2.660725	2.52762091	-0.00000006	2.52762085	-0.00000195	0.70943645	1.26089226	-0.00002706	0.42499995
2.818382	2.64600918	-0.00000003	2.64600915	-0.00000182	0.70962980	1.27540416	-0.00002611	0.44999993
2.985382	2.77138090	-0.00000012	2.77138078	-0.00000180	0.70979211	1.29025052	-0.00002563	0.47499996
3.162277	2.90415391	-0.00000012	2.90415379	-0.00000167	0.70992795	1.30543393	-0.00002466	0.49999994
3.349654	3.04477009	-0.00000012	3.04676957	-0.00000086	0.71003926	1.32095681	-0.00002408	0.52499998
3.548133	3.19369832	-0.00000012	3.19369820	-0.00000091	0.71013090	1.33682163	-0.00002360	0.54999995
3.758373	3.35143316	0.	3.35143316	-0.00000083	0.71020430	1.35303065	-0.00002265	0.57499993
3.981071	3.51850054	0.	3.51850054	0.00000053	0.71026278	1.36958627	-0.00002253	0.59999996
4.216964	3.69545498	0.00000012	3.69545510	0.00000280	0.71030921	1.38649075	-0.00002337	0.62499994
4.466835	3.88288522	0.00000015	3.88288537	0.00000340	0.71034503	1.40376435	-0.00002575	0.64999998
4.731512	4.08140874	0.00000012	4.08140886	0.00000216	0.71036661	1.42135486	-0.00002813	0.67499995
5.011871	4.29169315	0.	4.29169315	-0.0000009	0.71038628	1.43931936	-0.00002956	0.69999993
5.308844	4.51443392	0.00000006	4.51443398	0.00000207	0.71040159	1.45764183	-0.00003004	0.72499996
5.623412	4.75036550	0.	4.75036550	0.00000504	0.71040839	1.47632425	-0.00003386	0.74999994
5.956621	5.00027794	0.00000012	5.00027806	0.00000231	0.71041662	1.49536955	-0.00003695	0.77499998
6.309572	5.26499623	0.	5.26499623	0.00000142	0.71042258	1.51477982	-0.00003958	0.79999995
6.683438	5.54539806	0.	5.54539806	0.00000112	0.71042633	1.53455754	-0.00004101	0.82499993
7.079457	5.84241420	0.	5.84241420	0.00000104	0.71042866	1.55470531	-0.00004244	0.84999996
7.498940	6.15702808	0.	6.15702808	0.00000110	0.71043026	1.57522568	-0.00004387	0.87499994
7.943281	6.49028438	0.00000006	6.49028444	0.00000142	0.71043128	1.59612143	-0.00004554	0.89999998
8.413950	6.84328657	0.00000012	6.84328669	0.00000238	0.71043229	1.61730531	-0.00004840	0.92499995
8.912507	7.21720493	0.00000006	7.21720499	0.00000475	0.71043289	1.63905019	-0.00005388	0.94999993
9.440607	7.61328018	0.	7.61328018	0.00000159	0.71043313	1.66108918	-0.00006628	0.97499996
9.999998	8.03280711	0.00000012	8.03280723	0.00001074	0.71044167	1.683351439	-0.00008392	0.99999994
10.592536	8.47721028	0.00000012	8.47721040	0.00000466	0.710441131	1.70633082	-0.00009775	1.02499998
11.220182	8.94794536	-0.00000012	8.94794524	0.00000232	0.710441131	1.72954088	-0.00010538	1.04999995
11.885019	9.46657254	0.00000024	9.46657278	0.00000128	0.71044095	1.75314793	-0.00010777	1.07499993
12.589252	9.97474730	0.00000048	9.97474778	0.00000082	0.71044155	1.77715568	-0.00010967	1.09999996
13.335212	10.53421617	0.00000024	10.53421640	0.00000054	0.71044124	1.80156755	-0.00011206	1.12499994
14.125374	11.12683821	0.	11.12683821	0.0000041	0.71044159	1.82638754	-0.00011444	1.14999998
14.962353	11.75457227	0.00000012	11.75457239	0.00000032	0.71044064	1.85161932	-0.00011539	1.17499995
15.848928	12.41950357	0.00000024	12.41950381	0.00000111	0.710441036	1.87726705	-0.00011539	1.19999993
16.788038	13.12383521	0.00000012	13.12383533	-0.00000013	0.710440940	1.90333481	-0.00011587	1.22499996
17.782790	13.86989963	0.	13.86989963	-0.00000153	0.710440940	1.92892674	-0.00011444	1.24999994
18.836648	14.66017640	0.00000012	14.66017652	-0.00000213	0.710441393	1.95674755	-0.00010824	1.27499998
19.952619	15.49728060	0.	15.49728060	0.00000656	0.710441232	1.98410144	-0.00011635	1.29999995
21.134085	16.38395643	0.	16.38395643	0.00000513	0.71039009	2.01189208	-0.00013733	1.32499993
22.382707	17.32320762	0.	17.32320762	-0.00000623	0.71040273	2.04012635	-0.00013542	1.34999996
23.713732	18.31810951	0.	18.31810951	-0.00000644	0.71041393	2.06880784	-0.00011063	1.37499994
25.111861	19.37196207	-0.00000024	19.37196183	-0.00000484	0.71042156	2.09794158	-0.00008774	1.39999998
26.607245	20.48825479	-0.00000024	20.48825455	-0.00000386	0.71042752	2.12753263	-0.00006866	1.42499995
28.183822	21.67069221	-0.00000024	21.67069197	-0.00000276	0.71043348	2.15758634	-0.00005341	1.44999993
29.853821	22.92319345	-0.00000024	22.92319322	-0.00000155	0.71043658	2.18810806	-0.00004292	1.47499996
31.622769	24.24990606	-0.00000024	24.24990652	-0.00000106	0.71043873	2.21910322	-0.00003624	1.49999994
33.496534	25.65523124	-0.00000024	25.65523100	-0.00000073	0.71044064	2.25057751	-0.00003147	1.52499992
35.481331	27.14383006	0.	27.14383006	-0.0000066	0.71044159	2.28253672	-0.00002766	1.54999995
37.583729	28.72062993	0.	28.72062993	-0.00000077	0.71044350	2.31498659	-0.00002384	1.57499993
39.810710	30.39086723	0.00000024	30.39086747	0.00000158	0.71044636	2.34793335	-0.00002575	1.59999996
42.169640	32.16005659	0.	32.16005659	0.00000103	0.71044539	2.38138267	-0.00003624	1.62499994
44.668346	34.03409100	0.00000048	34.03409147	-0.00000124	0.71044159	2.41534141	-0.00003433	1.64999992
47.315116	36.01916933	0.	36.01916933	-0.00000009	0.71044254	2.44981572	-0.00003242	1.67499995
50.118709	38.12186337	0.	38.12186337	-0.00000039	0.71044159	2.48481190	-0.00003052	1.69999993
53.088434	40.34915972	0.	40.34915972	-0.00000030	0.71044540	2.52033699	-0.00002670	1.72499996
56.234119	42.70842218	0.	42.70842218	-0.00000019	0.71044350	2.55639744	-0.00002670	1.74999994
59.366195	45.20746234	0.	45.20746234	-0.00000034	0.71044731	2.59300032	-0.00002480	1.77499992
63.095718	47.85462332	0.	47.85462332	-0.00000012	0.71044588	2.63015270	-0.00002289	1.79999995
66.834373	50.65881607	0.00000048	50.65881654	-0.00000031	0.71044922	2.66786176	-0.00002098	1.82499993
70.794561	53.62875795	0.00000095	53.62875891	-0.00000010	0.71045017	2.70613480	-0.00001907	1.84999996
74.389398	56.77488613	0.00000048	56.77488661	-0.00000018	0.71045017	2.74497920	-0.00002098	1.87499994
79.432798	60.10743713	0.00000095	60.10743809	-0.00000046	0.71045208	2.78440267	-0.00001717	1.89999992
84.139492	63.63746023	0.00000048	63.63746071	0.00000036	0.71045494	2.82441297	-0.00001907	1.92499995
89.125064	67.37663364	0.	67.37663364	0.00000063	0.71044636	2.86501774	-0.00002670	1.94999993
94.406066	71.33738613	0.	71.33738613	-0.00000037	0.71044827	2.90622535	-0.00003052	1.97499996
99.999970	75.53281689	0.00000095	75.53281689	-0.00000055	0.71045208	2.94804364	-0.00002289	1.99999994

Appendix C

Numerical Results for the Non-Grey Atmosphere

This appendix contains the numerical results for the non-grey atmosphere at 68 τ 's and for 70 frequencies. $T_{\text{eff.}} = 10^4 \text{ K}$ and the composition is pure hydrogen. The first page contains a summary of the results; the following pages contain the monochromatic quantities τ_ν , B_ν , J_ν , F_ν . The notation used in the column headings is explained below.

For the first page,

1, 2, ..., 68 = τ -index. On the following pages, only this index appears to indicate the τ at which the monochromatic quantities are evaluated.

TAU = τ

DELTA F/F = relative error in the integrated flux

$$= \frac{F - F^{(n)}(\tau)}{F} = 1 - f^{(n)}(\tau)$$

DFDTAU/F = derivative of the normalized flux with respect to τ = $\frac{df^{(n)}(\tau)}{d\tau}$

On the following pages,

NU = ν = frequency in units of R

TAUNU = τ_ν

BNU = B_ν [ergs cm⁻² sec⁻¹ cps⁻¹]

JNU = J_ν [ergs cm⁻² sec⁻¹ cps⁻¹]

FNU = F_ν [ergs cm⁻² sec⁻¹ cps⁻¹]

	TAU	T	DELTA F/F	DFDTAU/F
1	0.	0.737183E 04	0.445768E-04	-0.406524E-03
2	1.000000E-07	0.737184E 04	0.445768E-04	-0.40741E-03
3	0.100000E-04	0.737235E 04	0.445917E-04	-0.404325E-03
4	1.000000E-03	0.740245E 04	0.428706E-04	-0.407210E-03
5	0.158489E-02	0.741686E 04	0.430420E-04	-0.406694E-03
6	0.251189E-02	0.743762E 04	0.431165E-04	-0.407591E-03
7	0.398107E-02	0.746720E 04	0.430197E-04	-0.409307E-03
8	0.630957E-02	0.750882E 04	0.424013E-04	-0.411209E-03
9	1.000000E-02	0.756650E 04	0.402853E-04	-0.416344E-03
10	0.125893E-01	0.760283E 04	0.405088E-04	-0.418931E-03
11	0.158489E-01	0.764502E 04	0.406504E-04	-0.421976E-03
12	0.199526E-01	0.769379E 04	0.405088E-04	-0.424792E-03
13	0.251187E-01	0.774988E 04	0.400022E-04	-0.429359E-03
14	0.316228E-01	0.781407E 04	0.388697E-04	-0.434221E-03
15	0.398107E-01	0.788714E 04	0.367686E-04	-0.440227E-03
16	0.501187E-01	0.796994E 04	0.333413E-04	-0.448595E-03
17	0.630957E-01	0.806332E 04	0.279993E-04	-0.457652E-03
18	0.794328E-01	0.816821E 04	0.200495E-04	-0.465134E-03
19	0.100000E-00	0.828562E 04	0.857562E-05	-0.470333E-03
20	0.112202E-00	0.834932E 04	0.109226E-04	-0.470336E-03
21	0.125893E-00	0.841656E 04	0.135154E-04	-0.475367E-03
22	0.141254E-00	0.848749E 04	0.163466E-04	-0.478685E-03
23	0.158489E-00	0.856227E 04	0.194088E-04	-0.483426E-03
24	0.177828E-00	0.864110E 04	0.228137E-04	-0.490479E-03
25	0.199526E-00	0.872416E 04	0.265390E-04	-0.497398E-03
26	0.223872E-00	0.881164E 04	0.307411E-04	-0.507188E-03
27	0.251189E-00	0.890378E 04	0.353307E-04	-0.513714E-03
28	0.281838E-00	0.900080E 04	0.405610E-04	-0.537537E-03
29	0.316228E-00	0.910297E 04	0.468493E-04	-0.568482E-03
30	0.354813E-00	0.921056E 04	0.546426E-04	-0.613651E-03
31	0.398107E-00	0.932386E 04	0.643879E-04	-0.661718E-03
32	0.446684E-00	0.944320E 04	0.764504E-04	-0.721339E-03
33	0.501187E-00	0.956892E 04	0.910014E-04	-0.774223E-03
34	0.562341E-00	0.970140E 04	0.107080E-03	-0.806029E-03
35	0.630957E-00	0.984107E 04	0.121921E-03	-0.800315E-03
36	0.707946E-00	0.998844E 04	0.135273E-03	-0.864684E-03
37	0.794328E-00	0.101440E 05	0.149354E-03	-0.973308E-03
38	0.891251E-00	0.103083E 05	0.164233E-03	-0.108367E-02
39	0.100000E 01	0.104820E 05	0.174254E-03	-0.114669E-02
40	0.112202E 01	0.106659E 05	0.184998E-03	-0.145331E-02
41	0.125893E 01	0.108605E 05	0.209168E-03	-0.180316E-02
42	0.141254E 01	0.110668E 05	0.275254E-03	-0.258952E-02
43	0.158489E 01	0.112856E 05	0.410944E-03	-0.332181E-02
44	0.177828E 01	0.115179E 05	0.730060E-03	-0.545914E-02
45	0.199526E 01	0.117639E 05	0.149249E-02	-0.923973E-02
46	0.251187E 01	0.123024E 05	0.762038E-03	-0.171661E-01
47	0.316228E 01	0.129085E 05	0.915162E-03	-0.300154E-01
48	0.398107E 01	0.135796E 05	0.160176E-02	-0.403833E-01
49	0.501187E 01	0.143128E 05	-0.256047E-02	-0.327548E-01
50	0.562341E 01	0.147016E 05	0.181720E-03	-0.225029E-01
51	0.630957E 01	0.151027E 05	0.278585E-03	-0.215296E-01
52	0.707946E 01	0.155170E 05	-0.247538E-03	-0.238760E-01
53	0.794328E 01	0.159435E 05	-0.773556E-03	-0.241666E-01
54	0.891251E 01	0.163834E 05	0.892267E-03	-0.338710E-01
55	0.100000E 02	0.168298E 05	0.961460E-03	-0.189695E-01
56	0.112202E 02	0.172947E 05	-0.100492E-02	-0.277028E-01
57	0.125893E 02	0.177718E 05	-0.674203E-03	-0.259842E-01
58	0.141254E 02	0.182633E 05	0.983924E-03	-0.301232E-01
59	0.158489E 02	0.187658E 05	-0.136331E-03	-0.171422E-01
60	0.177828E 02	0.192903E 05	-0.389978E-03	-0.309842E-01
61	0.199526E 02	0.198246E 05	0.234671E-03	-0.176063E-01
62	0.223872E 02	0.203806E 05	-0.292510E-03	-0.261249E-01
63	0.251189E 02	0.209500E 05	0.490308E-03	-0.186549E-01
64	0.281838E 02	0.215393E 05	-0.824094E-03	-0.200360E-01
65	0.316228E 02	0.221464E 05	0.123715E-02	-0.294409E-01
66	0.398107E 02	0.234149E 05	-0.101279E-02	-0.251852E-01
67	0.446684E 02	0.240795E 05	0.231609E-03	-0.154396E-01
68	0.501187E 02	0.247641E 05	-0.371441E-03	0.291292E-03

NU=	0.10000E 01	0.10000E 01	0.10000E 01	0.25000E-00	0.291667E-00	0.333333E-00	0.37500E-00	0.416667E-00
1	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU
2	0.	0.	0.	0.	0.	0.	0.	0.
3	0.152296E 01	0.152296E 01	0.152296E 01	0.130606E-05	0.824783E-06	0.553173E-06	0.388693E-06	0.283412E-06
4	0.152191E 03	0.152191E 03	0.152191E 03	0.130590E-03	0.824680E-04	0.553104E-04	0.388645E-04	0.283376E-04
5	0.146292E 05	0.146292E 05	0.146292E 05	0.129635E-01	0.818674E-02	0.549083E-02	0.385822E-02	0.281319E-02
6	0.122686E 05	0.122686E 05	0.122686E 05	0.204637E-01	0.129234E-01	0.866779E-02	0.609058E-02	0.444091E-02
7	0.529777E 05	0.529777E 05	0.529777E 05	0.507087E-01	0.320258E-01	0.214803E-01	0.150937E-01	0.110055E-01
8	0.791445E 05	0.791445E 05	0.791445E 05	0.794749E-01	0.501955E-01	0.336679E-01	0.236579E-01	0.172501E-01
9	0.115698E 06	0.115698E 06	0.115698E 06	0.174024E-00	0.783371E-01	0.525450E-01	0.369230E-01	0.269226E-01
10	0.138420E 06	0.138420E 06	0.138420E 06	0.154610E-00	0.976597E-01	0.655069E-01	0.460318E-01	0.335645E-01
11	0.164353E 06	0.164353E 06	0.164353E 06	0.192434E-00	0.121557E-00	0.815386E-01	0.572979E-01	0.417795E-01
12	0.193536E 06	0.193536E 06	0.193536E 06	0.239096E-00	0.151041E-00	0.101319E-00	0.711984E-01	0.519156E-01
13	0.225872E 06	0.225872E 06	0.225872E 06	0.296502E-00	0.187317E-00	0.125657E-00	0.883025E-01	0.643878E-01
14	0.261120E 06	0.261120E 06	0.261120E 06	0.364927E-00	0.231826E-00	0.155520E-00	0.109290E-00	0.796924E-01
15	0.298875E 06	0.298875E 06	0.298875E 06	0.453061E-00	0.286271E-00	0.192053E-00	0.134966E-00	0.984157E-01
16	0.338587E 06	0.338587E 06	0.338587E 06	0.558091E-00	0.352671E-00	0.236611E-00	0.166284E-00	0.121254E-00
17	0.379579E 06	0.379579E 06	0.379579E 06	0.685774E-00	0.433407E-00	0.290795E-00	0.204370E-00	0.149028E-00
18	0.421087E 06	0.421087E 06	0.421087E 06	0.840540E-00	0.531290E-00	0.356495E-00	0.250551E-00	0.182707E-00
19	0.462309E 06	0.462309E 06	0.462309E 06	0.102761E 01	0.649637E-00	0.433594E-00	0.306400E-00	0.223437E-00
20	0.482428E 06	0.482428E 06	0.482428E 06	0.113509E 01	0.717665E 00	0.481598E-00	0.338498E-00	0.246847E-00
21	0.502181E 06	0.502181E 06	0.502181E 06	0.155305E 01	0.792291E 00	0.531718E 00	0.373735E-00	0.272547E-00
22	0.521480E 06	0.521480E 06	0.521480E 06	0.178242E 01	0.874183E 00	0.586707E 00	0.412397E-00	0.300745E-00
23	0.540249E 06	0.540249E 06	0.540249E 06	0.152428E 01	0.963988E 00	0.647016E 00	0.454802E-00	0.331674E-00
24	0.558418E 06	0.558418E 06	0.558418E 06	0.167978E 01	0.106245E 01	0.713144E 00	0.501300E 00	0.365590E-00
25	0.575925E 06	0.575925E 06	0.575925E 06	0.195017E 01	0.117036E 01	0.785630E 00	0.552272E 00	0.402771E-00
26	0.592721E 06	0.592721E 06	0.592721E 06	0.203687E 01	0.128863E 01	0.865082E 00	0.608147E 00	0.443528E-00
27	0.608764E 06	0.608764E 06	0.608764E 06	0.224145E 01	0.141825E 01	0.952170E 00	0.669396E 00	0.488208E-00
28	0.624024E 06	0.624024E 06	0.624024E 06	0.246562E 01	0.156033E 01	0.104764E 01	0.736546E 00	0.537194E 00
29	0.638481E 06	0.638481E 06	0.638481E 06	0.271136E 01	0.171611E 01	0.115234E 01	0.810193E 00	0.590923E 00
30	0.652124E 06	0.652124E 06	0.652124E 06	0.298085E 01	0.188700E 01	0.126721E 01	0.891002E 00	0.649881E 00
31	0.664952E 06	0.664952E 06	0.664952E 06	0.327660E 01	0.207460E 01	0.139333E 01	0.979738E 00	0.714624E 00
32	0.676973E 06	0.676973E 06	0.676973E 06	0.360144E 01	0.228073E 01	0.153194E 01	0.107726E 01	0.78786E 00
33	0.688201E 06	0.688201E 06	0.688201E 06	0.395862E 01	0.250745E 01	0.168443E 01	0.118457E 01	0.864093E 00
34	0.698659E 06	0.698659E 06	0.698659E 06	0.435191E 01	0.2757179E 01	0.185243E 01	0.130282E 01	0.950385E 00
35	0.708372E 06	0.708372E 06	0.708372E 06	0.478565E 01	0.303273E 01	0.203784E 01	0.143333E 01	0.104564E 01
36	0.717373E 06	0.717373E 06	0.717373E 06	0.526491E 01	0.333773E 01	0.224286E 01	0.157767E 01	0.115099E 01
37	0.725695E 06	0.725695E 06	0.725695E 06	0.579564E 01	0.367479E 01	0.247006E 01	0.173765E 01	0.126777E 01
38	0.733377E 06	0.733377E 06	0.733377E 06	0.637848E 01	0.404962E 01	0.272250E 01	0.191544E 01	0.139757E 01
39	0.740456E 06	0.740456E 06	0.740456E 06	0.704077E 01	0.446713E 01	0.300378E 01	0.211358E 01	0.154225E 01
40	0.746971E 06	0.746971E 06	0.746971E 06	0.777328E 01	0.493365E 01	0.331820E 01	0.233512E 01	0.170402E 01
41	0.752962E 06	0.752962E 06	0.752962E 06	0.859408E 01	0.545674E 01	0.367088E 01	0.258368E 01	0.188556E 01
42	0.758467E 06	0.758467E 06	0.758467E 06	0.951714E 01	0.604539E 01	0.406794E 01	0.286359E 01	0.209004E 01
43	0.763523E 06	0.763523E 06	0.763523E 06	0.105593E 02	0.671046E 01	0.451676E 01	0.318009E 01	0.232128E 01
44	0.768167E 06	0.768167E 06	0.768167E 06	0.117407E 02	0.746501E 01	0.502623E 01	0.353947E 01	0.258391E 01
45	0.772433E 06	0.772433E 06	0.772433E 06	0.130855E 02	0.832465E 01	0.560697E 01	0.394928E 01	0.288347E 01
46	0.780080E 06	0.780080E 06	0.780080E 06	0.163891E 02	0.104394E 02	0.703698E 01	0.495904E 01	0.36287E 01
47	0.785652E 06	0.785652E 06	0.785652E 06	0.207769E 02	0.132539E 02	0.894297E 01	0.630621E 01	0.460765E 01
48	0.792092E 06	0.792092E 06	0.792092E 06	0.246835E 02	0.170516E 02	0.115190E 02	0.812904E 01	0.594755E 01
49	0.796863E 06	0.796863E 06	0.796863E 06	0.347068E 02	0.222236E 02	0.150337E 02	0.106195E 02	0.776807E 01
50	0.798986E 06	0.798986E 06	0.798986E 06	0.397570E 02	0.254856E 02	0.172538E 02	0.121943E 02	0.892329E 01
51	0.800981E 06	0.800981E 06	0.800981E 06	0.456555E 02	0.293010E 02	0.198534E 02	0.140397E 02	0.102778E 02
52	0.802863E 06	0.802863E 06	0.802863E 06	0.525399E 02	0.337609E 02	0.228954E 02	0.162010E 02	0.118652E 02
53	0.804645E 06	0.804645E 06	0.804645E 06	0.605655E 02	0.389679E 02	0.264512E 02	0.187295E 02	0.137234E 02
54	0.806338E 06	0.806338E 06	0.806338E 06	0.690722E 02	0.450382E 02	0.306014E 02	0.216834E 02	0.158958E 02
55	0.807954E 06	0.807954E 06	0.807954E 06	0.807576E 02	0.520999E 02	0.354353E 02	0.251272E 02	0.184303E 02
56	0.809500E 06	0.809500E 06	0.809500E 06	0.933300E 02	0.602973E 02	0.410537E 02	0.291338E 02	0.213811E 02
57	0.810982E 06	0.810982E 06	0.810982E 06	0.107875E 03	0.697919E 02	0.475696E 02	0.337850E 02	0.248094E 02
58	0.812407E 06	0.812407E 06	0.812407E 06	0.124645E 03	0.807599E 02	0.551065E 02	0.391707E 02	0.287822E 02
59	0.813779E 06	0.813779E 06	0.813779E 06	0.143933E 03	0.933946E 02	0.638004E 02	0.453389E 02	0.333736E 02
60	0.815103E 06	0.815103E 06	0.815103E 06	0.166053E 03	0.107910E 03	0.738019E 02	0.525520E 02	0.386661E 02
61	0.816380E 06	0.816380E 06	0.816380E 06	0.191346E 03	0.124535E 03	0.552733E 02	0.607762E 02	0.447487E 02
62	0.817616E 06	0.817616E 06	0.817616E 06	0.202017E 03	0.143519E 03	0.983908E 02	0.701914E 02	0.517188E 02
63	0.818181E 06	0.818181E 06	0.818181E 06	0.252941E 03	0.165129E 03	0.113344E 03	0.809369E 02	0.596814E 02
64	0.819967E 06	0.819967E 06	0.819967E 06	0.290048E 03	0.189647E 03	0.130334E 03	0.931610E 02	0.687485E 02
65	0.821088E 06	0.821088E 06	0.821088E 06	0.319194E 03	0.217375E 03	0.149578E 03	0.107023E 03	0.790415E 02
66	0.823248E 06	0.823248E 06	0.823248E 06	0.421855E 03	0.283683E 03	0.195699E 03	0.140311E 03	0.103797E 03
67	0.824270E 06	0.824270E 06	0.824270E 06	0.470937E 03	0.322997E 03	0.223107E 03	0.160130E 03	0.118560E 03
68	0.825262E 06	0.825262E 06	0.825262E 06	0.556754E 03	0.366870E 03	0.253740E 03	0.182310E 03	0.135100E 03

NU=	0.458333E-00	0.500000E-00	0.541667E 00	0.583333E 00	0.625000E 00	0.666667E 00	0.708333E 00	0.750000E 00
	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU
1	0.	0.	0.	0.	0.	0.	0.	0.
2	0.212948E-06	0.164030E-06	0.129015E-06	0.103298E-06	0.839850E-07	0.692015E-07	0.576938E-07	0.486025E-07
3	0.212922E-04	0.164009E-04	0.128999E-04	0.103285E-04	0.839744E-05	0.691929E-05	0.576866E-05	0.485964E-05
4	0.211376E-02	0.162819E-02	0.128063E-02	0.102535E-02	0.833649E-03	0.686907E-03	0.572679E-03	0.482437E-03
5	0.333679E-02	0.257026E-02	0.202161E-02	0.161862E-02	0.131600E-02	0.108435E-02	0.904033E-03	0.761577E-03
6	0.525899E-02	0.405089E-02	0.318618E-02	0.255105E-02	0.207410E-02	0.170901E-02	0.142481E-02	0.120029E-02
7	0.826932E-02	0.636970E-02	0.501001E-02	0.401132E-02	0.326136E-02	0.268728E-02	0.224040E-02	0.188736E-02
8	0.129614E-01	0.998393E-02	0.785275E-02	0.68739E-02	0.511189E-02	0.421207E-02	0.351163E-02	0.295828E-02
9	0.202292E-01	0.155822E-01	0.122560E-01	0.941290E-02	0.797827E-02	0.657390E-02	0.548071E-02	0.461707E-02
10	0.252198E-01	0.194264E-01	0.152796E-01	0.123338E-01	0.994656E-02	0.819572E-02	0.683283E-02	0.575612E-02
11	0.313925E-01	0.241811E-01	0.190194E-01	0.152281E-01	0.123811E-01	0.102017E-01	0.850522E-02	0.716498E-02
12	0.390087E-01	0.300478E-01	0.236338E-01	0.189227E-01	0.153849E-01	0.126768E-01	0.105687E-01	0.890332E-02
13	0.483803E-01	0.372667E-01	0.293118E-01	0.234689E-01	0.190811E-01	0.157224E-01	0.131078E-01	0.110423E-01
14	0.598803E-01	0.461251E-01	0.362793E-01	0.290475E-01	0.236168E-01	0.194596E-01	0.162236E-01	0.136671E-01
15	0.739492E-01	0.569624E-01	0.448033E-01	0.358723E-01	0.291657E-01	0.240318E-01	0.200355E-01	0.168783E-01
16	0.911102E-01	0.701815E-01	0.552008E-01	0.441972E-01	0.359341E-01	0.296089E-01	0.246851E-01	0.207953E-01
17	0.111198E-00	0.862579E-01	0.678457E-01	0.543216E-01	0.441657E-01	0.363914E-01	0.303398E-01	0.255898E-01
18	0.137288E-00	0.105753E-00	0.831796E-01	0.665599E-01	0.541177E-01	0.446164E-01	0.371970E-01	0.313356E-01
19	0.167895E-00	0.129330E-00	0.101724E-00	0.814471E-01	0.662199E-01	0.545636E-01	0.454901E-01	0.383218E-01
20	0.185487E-00	0.142882E-00	0.112383E-00	0.898916E-01	0.731587E-01	0.602811E-01	0.502568E-01	0.423374E-01
21	0.204800E-00	0.157759E-00	0.124085E-00	0.993508E-01	0.807763E-01	0.665578E-01	0.554898E-01	0.467458E-01
22	0.225990E-00	0.174083E-00	0.136925E-00	0.109631E-00	0.891349E-01	0.734451E-01	0.612317E-01	0.515829E-01
23	0.249233E-00	0.191987E-00	0.151008E-00	0.109090E-00	0.983030E-01	0.809994E-01	0.675298E-01	0.568886E-01
24	0.274721E-00	0.211622E-00	0.166452E-00	0.133273E-00	0.108357E-00	0.892836E-01	0.744364E-01	0.627068E-01
25	0.302663E-00	0.233147E-00	0.183383E-00	0.146830E-00	0.119379E-00	0.983654E-01	0.820080E-01	0.690853E-01
26	0.333294E-00	0.256744E-00	0.201944E-00	0.161691E-00	0.131462E-00	0.108321E-00	0.903085E-01	0.760778E-01
27	0.366873E-00	0.282612E-00	0.222292E-00	0.177983E-00	0.144708E-00	0.119236E-00	0.994081E-01	0.837436E-01
28	0.403690E-00	0.310975E-00	0.244601E-00	0.195846E-00	0.159231E-00	0.131203E-00	0.109385E-00	0.921485E-01
29	0.444071E-00	0.342085E-00	0.269072E-00	0.215439E-00	0.175162E-00	0.144330E-00	0.120329E-00	0.101368E-00
30	0.488384E-00	0.376223E-00	0.295925E-00	0.246940E-00	0.192644E-00	0.158734E-00	0.132338E-00	0.111485E-00
31	0.537047E-00	0.413714E-00	0.325416E-00	0.260553E-00	0.211842E-00	0.174554E-00	0.145527E-00	0.122595E-00
32	0.590537E-00	0.454924E-00	0.357832E-00	0.246509E-00	0.232946E-00	0.191943E-00	0.160024E-00	0.134808E-00
33	0.649399E-00	0.500273E-00	0.393505E-00	0.315073E-00	0.256170E-00	0.211079E-00	0.175979E-00	0.142484E-00
34	0.714266E-00	0.550251E-00	0.432820E-00	0.346552E-00	0.281765E-00	0.232169E-00	0.193562E-00	0.163061E-00
35	0.785873E-00	0.605423E-00	0.476221E-00	0.381304E-00	0.310020E-00	0.255451E-00	0.212972E-00	0.179413E-00
36	0.865076E-00	0.666450E-00	0.524228E-00	0.419745E-00	0.341275E-00	0.281205E-00	0.234446E-00	0.197501E-00
37	0.952879E-00	0.734105E-00	0.577451E-00	0.464236E-00	0.375927E-00	0.309758E-00	0.258249E-00	0.217555E-00
38	0.105047E-01	0.809307E-00	0.636611E-00	0.509734E-00	0.414444E-00	0.341497E-00	0.284710E-00	0.239846E-00
39	0.115926E-01	0.893138E-00	0.702562E-00	0.542545E-00	0.457384E-00	0.376879E-00	0.314209E-00	0.264698E-00
40	0.128092E-01	0.986892E-00	0.776322E-00	0.671610E-00	0.505401E-00	0.416453E-00	0.347203E-00	0.292492E-00
41	0.141745E-01	0.109211E-01	0.859107E-00	0.687903E-00	0.559313E-00	0.460870E-00	0.384234E-00	0.323689E-00
42	0.157125E-01	0.121065E-01	0.952370E-00	0.762588E-00	0.620041E-00	0.510911E-00	0.425955E-00	0.358836E-00
43	0.174520E-01	0.134473E-01	0.105787E-01	0.847072E-01	0.688738E-00	0.567519E-00	0.473151E-00	0.398596E-00
44	0.194279E-01	0.149704E-01	0.117772E-01	0.943054E-01	0.766786E-00	0.631833E-00	0.526773E-00	0.443769E-00
45	0.216819E-01	0.167081E-01	0.131446E-01	0.105257E-01	0.855838E-00	0.705216E-00	0.587795E-00	0.495313E-00
46	0.272396E-01	0.209934E-01	0.165171E-01	0.132268E-01	0.107550E-01	0.886232E-00	0.738880E-00	0.622459E-00
47	0.346624E-01	0.267184E-01	0.210235E-01	0.168366E-01	0.136907E-01	0.112816E-01	0.940600E-00	0.792402E-00
48	0.447194E-01	0.344779E-01	0.271328E-01	0.217311E-01	0.176716E-01	0.145626E-01	0.121417E-01	0.102288E-01
49	0.584817E-01	0.451008E-01	0.354991E-01	0.284435E-01	0.231251E-01	0.190576E-01	0.158900E-01	0.133869E-01
50	0.671195E-01	0.518295E-01	0.407998E-01	0.326835E-01	0.265813E-01	0.219066E-01	0.182658E-01	0.153887E-01
51	0.774167E-01	0.597245E-01	0.470206E-01	0.376700E-01	0.306385E-01	0.252512E-01	0.210552E-01	0.177389E-01
52	0.894002E-01	0.689838E-01	0.543180E-01	0.437520E-01	0.353992E-01	0.291761E-01	0.243285E-01	0.204971E-01
53	0.103436E-02	0.798323E-01	0.628701E-01	0.503780E-01	0.409801E-01	0.337776E-01	0.281665E-01	0.237312E-01
54	0.119852E-02	0.925258E-01	0.728794E-01	0.584055E-01	0.475142E-01	0.391656E-01	0.326607E-01	0.275185E-01
55	0.139015E-02	0.107349E-02	0.845713E-01	0.677846E-01	0.551495E-01	0.454623E-01	0.379134E-01	0.319452E-01
56	0.161338E-02	0.124624E-02	0.982016E-01	0.787212E-01	0.640544E-01	0.528069E-01	0.440408E-01	0.371094E-01
57	0.187289E-02	0.144715E-02	0.114060E-02	0.914485E-01	0.744192E-01	0.613570E-01	0.511745E-01	0.431222E-01
58	0.217381E-02	0.168024E-02	0.132464E-02	0.176223E-02	0.864540E-01	0.712861E-01	0.594599E-01	0.501063E-01
59	0.252181E-02	0.194933E-02	0.153766E-02	0.173330E-02	0.100392E-02	0.8227871E-01	0.690582E-01	0.581979E-01
60	0.292323E-02	0.226119E-02	0.178362E-02	0.143088E-02	0.116493E-02	0.960761E-01	0.801502E-01	0.675497E-01
61	0.338491E-02	0.261938E-02	0.206679E-02	0.145844E-02	0.135042E-02	0.111388E-02	0.929329E-01	0.783283E-01
62	0.391434E-02	0.303037E-02	0.239187E-02	0.191976E-02	0.156350E-02	0.128982E-02	0.107623E-02	0.907166E-01
63	0.451964E-02	0.350056E-02	0.276394E-02	0.271898E-02	0.180755E-02	0.149138E-02	0.124455E-02	0.104914E-02
64	0.520946E-02	0.403675E-02	0.318848E-02	0.256053E-02	0.208623E-02	0.172160E-02	0.143685E-02	0.121136E-02
65	0.599319E-02	0.464636E-02	0.367140E-02	0.294923E-02	0.240349E-02	0.198376E-02	0.165588E-02	0.139617E-02
66	0.788062E-02	0.611605E-02	0.483672E-02	0.308787E-02	0.317006E-02	0.261752E-02	0.218557E-02	0.184322E-02
67	0.900773E-02	0.699468E-02	0.553403E-02	0.444997E-02	0.362941E-02	0.299746E-02	0.250326E-02	0.21144E-02
68	0.102717E-03	0.798079E-02	0.631715E-02	0.508158E-02	0.414579E-02	0.342475E-02	0.286063E-02	0.241324E-02

NU#	0.791667E 00	0.833333E 00	0.875000E 00	0.916667E 00	0.958333E 00	1.000000E 00	0.111111E-00	0.118827E-00
1	0.	TAUNU	0.	TAUNU	0.	TAUNU	0.	TAUNU
2	0.413252E-07	0.354312E-07	0.306068E-07	0.266200E-07	0.232966E-07	0.205042E-07	0.263973E-06	0.219170E-06
3	0.413200E-05	0.354268E-05	0.306030E-05	0.266167E-05	0.232937E-05	0.205016E-05	0.263968E-04	0.219166E-04
4	0.410201E-03	0.351696E-03	0.303809E-03	0.264235E-03	0.231246E-03	0.203528E-03	0.263701E-02	0.218956E-02
5	0.647546E-03	0.555190E-03	0.479594E-03	0.417122E-03	0.365046E-03	0.321290E-03	0.417707E-02	0.346841E-02
6	0.102057E-02	0.875014E-03	0.755870E-03	0.657411E-03	0.575336E-03	0.506374E-03	0.661512E-02	0.549305E-02
7	0.160477E-02	0.137589E-02	0.118854E-02	0.103373E-02	0.904669E-03	0.796232E-03	0.104728E-01	0.869692E-02
8	0.251533E-02	0.215658E-02	0.186294E-02	0.162027E-02	0.141799E-02	0.124802E-02	0.165731E-01	0.137639E-01
9	0.392575E-02	0.336584E-02	0.290754E-02	0.252881E-02	0.221310E-02	0.194782E-02	0.262117E-01	0.217713E-01
10	0.489426E-02	0.419621E-02	0.362485E-02	0.315268E-02	0.275908E-02	0.242836E-02	0.329554E-01	0.273745E-01
11	0.609217E-02	0.522327E-02	0.451206E-02	0.392432E-02	0.343439E-02	0.302273E-02	0.414255E-01	0.344133E-01
12	0.757023E-02	0.649052E-02	0.560676E-02	0.497664E-02	0.426762E-02	0.375609E-02	0.520620E-01	0.432537E-01
13	0.938896E-02	0.804986E-02	0.695377E-02	0.604798E-02	0.529292E-02	0.465849E-02	0.654148E-01	0.545358E-01
14	0.116208E-01	0.996334E-02	0.860671E-02	0.748561E-02	0.655106E-02	0.576582E-02	0.821751E-01	0.682893E-01
15	0.143511E-01	0.123043E-01	0.106289E-01	0.924440E-02	0.809027E-02	0.712054E-02	0.103207E-00	0.857803E-01
16	0.176816E-01	0.151598E-01	0.130956E-01	0.113897E-01	0.996779E-02	0.877301E-02	0.129596E-00	0.107733E-00
17	0.217320E-01	0.186324E-01	0.160954E-01	0.139988E-01	0.122511E-01	0.107827E-01	0.162710E-00	0.135288E-00
18	0.266437E-01	0.228436E-01	0.197332E-01	0.171628E-01	0.150201E-01	0.132197E-01	0.204270E-00	0.169882E-00
19	0.325839E-01	0.279366E-01	0.241327E-01	0.209892E-01	0.183688E-01	0.161670E-01	0.256453E-00	0.213336E-00
20	0.359982E-01	0.308640E-01	0.266615E-01	0.231886E-01	0.202936E-01	0.178611E-01	0.287364E-00	0.239083E-00
21	0.397465E-01	0.340777E-01	0.294376E-01	0.256031E-01	0.224066E-01	0.197209E-01	0.322024E-00	0.267959E-00
22	0.438594E-01	0.376040E-01	0.324837E-01	0.282524E-01	0.247252E-01	0.217616E-01	0.360899E-00	0.300355E-00
23	0.483706E-01	0.414717E-01	0.358249E-01	0.311584E-01	0.272684E-01	0.239999E-01	0.404521E-00	0.336714E-00
24	0.533177E-01	0.457133E-01	0.394889E-01	0.343451E-01	0.300572E-01	0.264545E-01	0.453498E-00	0.377547E-00
25	0.587412E-01	0.503632E-01	0.435057E-01	0.378387E-01	0.331147E-01	0.291454E-01	0.508515E-00	0.423427E-00
26	0.646867E-01	0.554608E-01	0.479091E-01	0.416685E-01	0.364664E-01	0.320954E-01	0.570363E-00	0.475018E-00
27	0.712046E-01	0.610491E-01	0.527365E-01	0.458761E-01	0.401408E-01	0.353293E-01	0.639949E-00	0.533080E-00
28	0.783511E-01	0.671763E-01	0.580294E-01	0.504705E-01	0.441695E-01	0.388752E-01	0.718313E-00	0.598485E-00
29	0.861899E-01	0.738971E-01	0.638351E-01	0.555200E-01	0.485886E-01	0.427645E-01	0.806668E-00	0.672251E-00
30	0.967920E-01	0.812723E-01	0.702061E-01	0.610611E-01	0.534379E-01	0.470326E-01	0.906410E-00	0.755551E-00
31	0.104239E-00	0.893720E-01	0.772029E-01	0.671465E-01	0.587635E-01	0.517199E-01	0.101918E-01	0.849763E-00
32	0.114623E-00	0.982753E-01	0.848939E-01	0.738357E-01	0.646176E-01	0.568723E-01	0.114690E-01	0.956500E-00
33	0.126051E-00	0.108073E-00	0.933577E-01	0.811970E-01	0.710599E-01	0.625424E-01	0.129182E-01	0.107766E-01
34	0.138646E-00	0.118871E-00	0.102868E-00	0.883099E-01	0.781600E-01	0.687914E-01	0.145663E-01	0.121549E-01
35	0.152550E-00	0.130792E-00	0.112983E-00	0.982662E-01	0.859981E-01	0.756900E-01	0.164451E-01	0.137268E-01
36	0.167929E-00	0.143979E-00	0.124347E-00	0.108173E-00	0.946683E-01	0.833210E-01	0.185928E-01	0.155244E-01
37	0.184981E-00	0.158598E-00	0.137003E-00	0.119157E-00	0.104281E-00	0.917813E-01	0.210553E-01	0.175864E-01
38	0.203935E-00	0.174849E-00	0.151041E-00	0.131366E-00	0.114966E-00	0.101186E-00	0.238882E-01	0.199595E-01
39	0.225065E-00	0.192965E-00	0.166691E-00	0.144978E-00	0.126878E-00	0.111670E-00	0.271590E-01	0.227007E-01
40	0.248698E-00	0.213228E-00	0.184194E-00	0.162020E-00	0.140201E-00	0.123396E-00	0.309504E-01	0.258798E-01
41	0.275224E-00	0.235970E-00	0.203840E-00	0.177288E-00	0.155155E-00	0.136557E-00	0.353364E-01	0.295824E-01
42	0.305109E-00	0.261593E-00	0.225974E-00	0.196539E-00	0.172002E-00	0.151385E-00	0.405247E-01	0.339139E-01
43	0.338916E-00	0.290578E-00	0.251013E-00	0.218316E-00	0.191061E-00	0.168159E-00	0.465877E-01	0.390053E-01
44	0.377325E-00	0.323510E-00	0.279461E-00	0.243059E-00	0.212714E-00	0.187217E-00	0.537460E-01	0.450195E-01
45	0.421152E-00	0.361087E-00	0.311921E-00	0.271290E-00	0.237421E-00	0.208963E-00	0.622384E-01	0.521595E-01
46	0.529263E-00	0.453780E-00	0.391993E-00	0.349933E-00	0.298369E-00	0.262260E-00	0.845015E-01	0.708932E-01
47	0.673766E-00	0.577675E-00	0.499020E-00	0.434019E-00	0.379835E-00	0.334306E-00	0.116756E-02	0.980682E-01
48	0.869748E 00	0.745711E 00	0.644178E 00	0.560271E 00	0.490325E 00	0.431553E 00	0.164171E 02	0.138069E 02
49	0.113829E 01	0.975961E 00	0.843083E 00	0.773270E 00	0.641727E 00	0.564809E 00	0.234465E 02	0.197451E 02
50	0.130851E 01	0.112192E 01	0.969171E 00	0.842936E 00	0.737704E 00	0.649283E 00	0.281573E 02	0.237285E 02
51	0.150837E 01	0.129328E 01	0.111721E 01	0.971699E 00	0.850394E 00	0.748466E 00	0.338956E 02	0.285841E 02
52	0.174293E 01	0.149494E 01	0.129096E 01	0.112282E 01	0.982654E 00	0.864876E 00	0.408748E 02	0.344936E 02
53	0.201796E 01	0.173025E 01	0.149470E 01	0.130003E 01	0.113775E 01	0.100138E 01	0.493451E 02	0.416704E 02
54	0.234006E 01	0.200644E 01	0.173331E 01	0.150758E 01	0.131939E 01	0.116125E 01	0.595998E 02	0.503649E 02
55	0.271654E 01	0.232928E 01	0.201224E 01	0.175019E 01	0.153172E 01	0.134814E 01	0.719737E 02	0.608630E 02
56	0.315578E 01	0.270596E 01	0.233766E 01	0.203325E 01	0.177946E 01	0.156620E 01	0.868582E 02	0.734991E 02
57	0.366722E 01	0.314566E 01	0.271661E 01	0.232688E 01	0.206796E 01	0.182013E 01	0.104709E 03	0.886633E 02
58	0.426131E 01	0.365407E 01	0.315684E 01	0.274582E 01	0.240312E 01	0.211514E 01	0.126041E 03	0.106796E 03
59	0.494966E 01	0.424445E 01	0.366696E 01	0.318956E 01	0.279151E 01	0.245701E 01	0.151437E 03	0.128396E 03
60	0.574528E 01	0.492688E 01	0.425663E 01	0.370254E 01	0.324051E 01	0.285223E 01	0.181568E 03	0.154039E 03
61	0.666237E 01	0.571355E 01	0.493642E 01	0.429392E 01	0.375815E 01	0.330788E 01	0.217180E 03	0.184366E 03
62	0.771652E 01	0.661786E 01	0.571791E 01	0.497381E 01	0.435329E 01	0.383176E 01	0.259109E 03	0.220092E 03
63	0.892478E 01	0.765446E 01	0.661379E 01	0.575326E 01	0.503560E 01	0.443239E 01	0.308285E 03	0.262019E 03
64	0.103055E 02	0.883912E 01	0.763770E 01	0.664415E 01	0.581549E 01	0.511895E 01	0.365728E 03	0.311021E 03
65	0.118786E 02	0.101891E 02	0.880458E 01	0.765951E 01	0.670439E 01	0.590151E 01	0.432567E 03	0.368073E 03
66	0.156851E 02	0.134561E 02	0.116290E 02	0.101174E 02	0.885641E 01	0.779620E 01	0.599148E 03	0.510379E 03
67	0.179695E 02	0.154171E 02	0.133246E 02	0.115933E 02	0.101487E 02	0.893404E 01	0.701917E 03	0.598242E 03
68	0.205404E 02	0.176245E 02	0.152334E 02	0.132548E 02	0.116038E 02	0.102153E 02	0.819587E 03	0.698900E 03

Nu=	0.126543E-00	0.134259E-00	0.141975E-00	0.149691E-00	0.157407E-00	0.165123E-00	0.172839E-00	0.180556E-00
1	0.	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU
2	0.183827E-06	0.155590E-06	0.132773E-06	0.114148E-06	0.988021E-07	0.860522E-07	0.753769E-07	0.663751E-07
3	0.183824E-04	0.155597E-04	0.132771E-04	0.114146E-04	0.988008E-05	0.860511E-05	0.753760E-05	0.663743E-05
4	0.183657E-02	0.155453E-02	0.132662E-02	0.114056E-02	0.987257E-03	0.859881E-03	0.753227E-03	0.663290E-03
5	0.290931E-02	0.246259E-02	0.210159E-02	0.1P0688E-02	0.156405E-02	0.136228E-02	0.119333E-02	0.105085E-02
6	0.460777E-02	0.390038E-02	0.332872E-02	0.296200E-02	0.247743E-02	0.215787E-02	0.189029E-02	0.166463E-02
7	0.729567E-02	0.617594E-02	0.527098E-02	0.453211E-02	0.392326E-02	0.341732E-02	0.299364E-02	0.263634E-02
8	0.115471E-01	0.977553E-02	0.834364E-02	0.717445E-02	0.621093E-02	0.541021E-02	0.473965E-02	0.417410E-02
9	0.182668E-01	0.154657E-01	0.132015E-01	0.113525E-01	0.982853E-02	0.856197E-02	0.750118E-02	0.660645E-02
10	0.229697E-01	0.194487E-01	0.166022E-01	0.142776E-01	0.123615E-01	0.107690E-01	0.943511E-02	0.830996E-02
11	0.288781E-01	0.244531E-01	0.208756E-01	0.179537E-01	0.155451E-01	0.135431E-01	0.118661E-01	0.104514E-01
12	0.362999E-01	0.307403E-01	0.262449E-01	0.275730E-01	0.195459E-01	0.170296E-01	0.149216E-01	0.131433E-01
13	0.562030E-01	0.386369E-01	0.329897E-01	0.293763E-01	0.245728E-01	0.214106E-01	0.187614E-01	0.165263E-01
14	0.573237E-01	0.485543E-01	0.416171E-01	0.356669E-01	0.308887E-01	0.269158E-01	0.235870E-01	0.207783E-01
15	0.720163E-01	0.610071E-01	0.520101E-01	0.448244E-01	0.388231E-01	0.338325E-01	0.296506E-01	0.261217E-01
16	0.904614E-01	0.766437E-01	0.656444E-01	0.563276E-01	0.487916E-01	0.425238E-01	0.372709E-01	0.328376E-01
17	0.113619E-00	0.962806E-01	0.822495E-01	0.707779E-01	0.613179E-01	0.534471E-01	0.468497E-01	0.412808E-01
18	0.142703E-00	0.120949E-00	0.103340E-00	0.894936E-01	0.770645E-01	0.671810E-01	0.588952E-01	0.518999E-01
19	0.179246E-00	0.151954E-00	0.129857E-00	0.111786E-00	0.968718E-01	0.844604E-01	0.740531E-01	0.656252E-01
20	0.200905E-00	0.170335E-00	0.145581E-00	0.125334E-00	0.108622E-00	0.947123E-01	0.830478E-01	0.731974E-01
21	0.225201E-00	0.190957E-00	0.163225E-00	0.140538E-00	0.121810E-00	0.106221E-00	0.931465E-01	0.821039E-01
22	0.252463E-00	0.214102E-00	0.183030E-00	0.157608E-00	0.136619E-00	0.119146E-00	0.104489E-00	0.921082E-01
23	0.283068E-00	0.240090E-00	0.205273E-00	0.176782E-00	0.153255E-00	0.133667E-00	0.117234E-00	0.103351E-00
24	0.317445E-00	0.269288E-00	0.230267E-00	0.18331E-00	0.171956E-00	0.149993E-00	0.131565E-00	0.115995E-00
25	0.356082E-00	0.302109E-00	0.258369E-00	0.225265E-00	0.192990E-00	0.168358E-00	0.147688E-00	0.130222E-00
26	0.399539E-00	0.339035E-00	0.289992E-00	0.249839E-00	0.216667E-00	0.189035E-00	0.165843E-00	0.146244E-00
27	0.448458E-00	0.380611E-00	0.325606E-00	0.290563E-00	0.243343E-00	0.212334E-00	0.186305E-00	0.164303E-00
28	0.503580E-00	0.427471E-00	0.365754E-00	0.315205E-00	0.273428E-00	0.238161E-00	0.209389E-00	0.184681E-00
29	0.565765E-00	0.480350E-00	0.411070E-00	0.354315E-00	0.307400E-00	0.262829E-00	0.235465E-00	0.207704E-00
30	0.636009E-00	0.540097E-00	0.462246E-00	0.398527E-00	0.345811E-00	0.301867E-00	0.264960E-00	0.233749E-00
31	0.715479E-00	0.607711E-00	0.520260E-00	0.448586E-00	0.389313E-00	0.339892E-00	0.298377E-00	0.263262E-00
32	0.805542E-00	0.684361E-00	0.586000E-00	0.5053635E-00	0.438665E-00	0.383040E-00	0.336304E-00	0.296766E-00
33	0.907808E-00	0.771423E-00	0.660692E-00	0.5649893E-00	0.494767E-00	0.432101E-00	0.379437E-00	0.334876E-00
34	0.102419E-01	0.870535E-00	0.745747E-00	0.643394E-00	0.558688E-00	0.488013E-00	0.428605E-00	0.378326E-00
35	0.115697E-01	0.983646E-00	0.842846E-00	0.777328E-00	0.631700E-00	0.551893E-00	0.484793E-00	0.427991E-00
36	0.130886E-01	0.111309E-01	0.954005E-00	0.873444E-00	0.715334E-00	0.625086E-00	0.549188E-00	0.484923E-00
37	0.148316E-01	0.126169E-01	0.108165E-01	0.933851E-00	0.811432E-00	0.707920E-00	0.623219E-00	0.550389E-00
38	0.168385E-01	0.143284E-01	0.122873E-01	0.176111E-01	0.922231E-00	0.806231E-00	0.708623E-00	0.625933E-00
39	0.191577E-01	0.163071E-01	0.139882E-01	0.120834E-01	0.105046E-01	0.918547E-00	0.807518E-00	0.713433E-00
40	0.218485E-01	0.186037E-01	0.159633E-01	0.177935E-01	0.119946E-01	0.104910E-01	0.922505E-00	0.815197E-00
41	0.249838E-01	0.212810E-01	0.182667E-01	0.157886E-01	0.137334E-01	0.120151E-01	0.105678E-01	0.934072E-00
42	0.286535E-01	0.244159E-01	0.209649E-01	0.191268E-01	0.157720E-01	0.138025E-01	0.121432E-01	0.107358E-01
43	0.329691E-01	0.281045E-01	0.241410E-01	0.208802E-01	0.181736E-01	0.159090E-01	0.140003E-01	0.123809E-01
44	0.380698E-01	0.324661E-01	0.278985E-01	0.251389E-01	0.210171E-01	0.184040E-01	0.162009E-01	0.143309E-01
45	0.441279E-01	0.376490E-01	0.323656E-01	0.290149E-01	0.244006E-01	0.213741E-01	0.188214E-01	0.166538E-01
46	0.600377E-01	0.512718E-01	0.441621E-01	0.392182E-01	0.333138E-01	0.292034E-01	0.257334E-01	0.227846E-01
47	0.831438E-01	0.710788E-01	0.612194E-01	0.570842E-01	0.463130E-01	0.406323E-01	0.358321E-01	0.317491E-01
48	0.117198E-02	0.100306E-02	0.864853E-01	0.750691E-01	0.655566E-01	0.575678E-01	0.508104E-01	0.450571E-01
49	0.167817E-02	0.143803E-02	0.124132E-02	0.107864E-02	0.942930E-01	0.828833E-01	0.732221E-01	0.649878E-01
50	0.201805E-02	0.173034E-02	0.149453E-02	0.179940E-02	0.113652E-02	0.999508E-01	0.883426E-01	0.784382E-01
51	0.243261E-02	0.208712E-02	0.180377E-02	0.156916E-02	0.137321E-02	0.120829E-02	0.106849E-02	0.949203E-01
52	0.293747E-02	0.252188E-02	0.218083E-02	0.198272E-02	0.166214E-02	0.146328E-02	0.129466E-02	0.115064E-02
53	0.355101E-02	0.305055E-02	0.263960E-02	0.279893E-02	0.201408E-02	0.177405E-02	0.157036E-02	0.139638E-02
54	0.429476E-02	0.369181E-02	0.319642E-02	0.275500E-02	0.244171E-02	0.215186E-02	0.190574E-02	0.169542E-02
55	0.519336E-02	0.446706E-02	0.386996E-02	0.374743E-02	0.295955E-02	0.260960E-02	0.231230E-02	0.205810E-02
56	0.627564E-02	0.540133E-02	0.468214E-02	0.478489E-02	0.358467E-02	0.316246E-02	0.280358E-02	0.249657E-02
57	0.757524E-02	0.652386E-02	0.565854E-02	0.493954E-02	0.433701E-02	0.382818E-02	0.339545E-02	0.302507E-02
58	0.913018E-02	0.786775E-02	0.682813E-02	0.596386E-02	0.523920E-02	0.462690E-02	0.410591E-02	0.365978E-02
59	0.109836E-03	0.947053E-02	0.822384E-02	0.718686E-02	0.631695E-02	0.558154E-02	0.495549E-02	0.441913E-02
60	0.131852E-03	0.113755E-03	0.988363E-02	0.864206E-02	0.759998E-02	0.671860E-02	0.596791E-02	0.532445E-02
61	0.157905E-03	0.136310E-03	0.118499E-03	0.103669E-03	0.912154E-02	0.806772E-02	0.716974E-02	0.639967E-02
62	0.188614E-03	0.162912E-03	0.141702E-03	0.1274033E-03	0.109189E-03	0.966223E-02	0.859086E-02	0.767166E-02
63	0.224673E-03	0.194165E-03	0.168977E-03	0.147985E-03	0.130340E-03	0.115395E-03	0.102648E-03	0.917063E-02
64	0.266841E-03	0.230733E-03	0.200908E-03	0.176039E-03	0.155126E-03	0.137405E-03	0.122283E-03	0.109298E-03
65	0.315963E-03	0.273355E-03	0.238144E-03	0.208771E-03	0.184060E-03	0.163110E-03	0.145226E-03	0.129862E-03
66	0.438592E-03	0.379842E-03	0.331249E-03	0.290678E-03	0.256515E-03	0.227529E-03	0.202764E-03	0.181471E-03
67	0.514366E-03	0.445692E-03	0.388686E-03	0.341403E-03	0.301420E-03	0.267481E-03	0.238473E-03	0.213521E-03
68	0.601219E-03	0.521209E-03	0.454978E-03	0.399633E-03	0.352993E-03	0.313387E-03	0.279522E-03	0.250381E-03

NU=	0.188272E-00	0.195988E-00	0.203704E-00	0.211420E-00	0.219136E-00	0.226852E-00	0.234568E-00	0.242284E-00
1	0.	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU	TAUNU
2	0.587347E-07	0.522102E-07	0.466072E-07	0.417702E-07	0.375738E-07	0.339163E-07	0.307147E-07	0.279008E-07
3	0.587340E-05	0.522096E-05	0.466067E-05	0.417697E-05	0.375734E-05	0.339159E-05	0.307144E-05	0.279005E-05
4	0.586950E-03	0.521759E-03	0.465774E-03	0.417440E-03	0.375507E-03	0.338959E-03	0.306966E-03	0.278845E-03
5	0.929917E-03	0.826642E-03	0.737948E-03	0.641376E-03	0.594943E-03	0.537040E-03	0.486353E-03	0.441802E-03
6	0.147308E-02	0.130950E-02	0.116902E-02	0.104773E-02	0.942495E-03	0.850774E-03	0.770482E-03	0.699908E-03
7	0.233303E-02	0.207400E-02	0.185153E-02	0.165945E-02	0.149280E-02	0.134754E-02	0.122038E-02	0.110861E-02
8	0.369399E-02	0.328395E-02	0.293176E-02	0.267268E-02	0.236384E-02	0.213386E-02	0.193253E-02	0.175555E-02
9	0.584683E-02	0.519802E-02	0.464073E-02	0.415952E-02	0.374198E-02	0.337800E-02	0.305935E-02	0.277924E-02
10	0.735469E-02	0.653872E-02	0.583782E-02	0.523260E-02	0.470742E-02	0.424961E-02	0.384879E-02	0.349644E-02
11	0.925030E-02	0.822427E-02	0.734289E-02	0.658179E-02	0.592133E-02	0.534556E-02	0.484145E-02	0.439829E-02
12	0.116332E-01	0.103433E-01	0.923509E-02	0.877809E-02	0.744759E-02	0.672356E-02	0.608962E-02	0.5553231E-02
13	0.146283E-01	0.130068E-01	0.116136E-01	0.104105E-01	0.936635E-02	0.845601E-02	0.765890E-02	0.695811E-02
14	0.183929E-01	0.163548E-01	0.146037E-01	0.130913E-01	0.117787E-01	0.106342E-01	0.963203E-02	0.875092E-02
15	0.231243E-01	0.205631E-01	0.183624E-01	0.144614E-01	0.148115E-01	0.133728E-01	0.121129E-01	0.110051E-01
16	0.290717E-01	0.258535E-01	0.230879E-01	0.206988E-01	0.186250E-01	0.168165E-01	0.152328E-01	0.138401E-01
17	0.365496E-01	0.325059E-01	0.290306E-01	0.260282E-01	0.234216E-01	0.211484E-01	0.191575E-01	0.174067E-01
18	0.459560E-01	0.408751E-01	0.365078E-01	0.373734E-01	0.294579E-01	0.266003E-01	0.240973E-01	0.218960E-01
19	0.577796E-01	0.514118E-01	0.459227E-01	0.411792E-01	0.370602E-01	0.334672E-01	0.303197E-01	0.275514E-01
20	0.648251E-01	0.576668E-01	0.515122E-01	0.461934E-01	0.415744E-01	0.375451E-01	0.340152E-01	0.309103E-01
21	0.727175E-01	0.646913E-01	0.577900E-01	0.518253E-01	0.466452E-01	0.421260E-01	0.381666E-01	0.346838E-01
22	0.815836E-01	0.725832E-01	0.648435E-01	0.591537E-01	0.523433E-01	0.472739E-01	0.428322E-01	0.389248E-01
23	0.915486E-01	0.814540E-01	0.727727E-01	0.652682E-01	0.587497E-01	0.530621E-01	0.480784E-01	0.436940E-01
24	0.102756E-00	0.914319E-01	0.816922E-01	0.732720E-01	0.659575E-01	0.595748E-01	0.539815E-01	0.490606E-01
25	0.115368E-00	0.102662E-00	0.917319E-01	0.872818E-01	0.740718E-01	0.669071E-01	0.606280E-01	0.551033E-01
26	0.129574E-00	0.115312E-00	0.103042E-00	0.974327E-01	0.832146E-01	0.751694E-01	0.681181E-01	0.619134E-01
27	0.145588E-00	0.129574E-00	0.115797E-00	0.107388E-00	0.935260E-01	0.848485E-01	0.765668E-01	0.695957E-01
28	0.163660E-00	0.145671E-00	0.130191E-00	0.116803E-00	0.105167E-00	0.950106E-01	0.861069E-01	0.782708E-01
29	0.184081E-00	0.163862E-00	0.146462E-00	0.111410E-00	0.118328E-00	0.106907E-00	0.968937E-01	0.880805E-01
30	0.207187E-00	0.184448E-00	0.164877E-00	0.147944E-00	0.133226E-00	0.120375E-00	0.109107E-00	0.991883E-01
31	0.233374E-00	0.207783E-00	0.185753E-00	0.166691E-00	0.150119E-00	0.135648E-00	0.122959E-00	0.111787E-00
32	0.263106E-00	0.234281E-00	0.209462E-00	0.197985E-00	0.169311E-00	0.153001E-00	0.138698E-00	0.126104E-00
33	0.296931E-00	0.264432E-00	0.236445E-00	0.212222E-00	0.191157E-00	0.172757E-00	0.156618E-00	0.142047E-00
34	0.335504E-00	0.298820E-00	0.267225E-00	0.239873E-00	0.216084E-00	0.195302E-00	0.177071E-00	0.161016E-00
35	0.379603E-00	0.338143E-00	0.302426E-00	0.271502E-00	0.244602E-00	0.221098E-00	0.200476E-00	0.183123E-00
36	0.430165E-00	0.383237E-00	0.342802E-00	0.307787E-00	0.277321E-00	0.250698E-00	0.227336E-00	0.206756E-00
37	0.488320E-00	0.435114E-00	0.389260E-00	0.349543E-00	0.314981E-00	0.284737E-00	0.258261E-00	0.234902E-00
38	0.555442E-00	0.495002E-00	0.442903E-00	0.397767E-00	0.358482E-00	0.324139E-00	0.293992E-00	0.267428E-00
39	0.633206E-00	0.564402E-00	0.505078E-00	0.453673E-00	0.408921E-00	0.369791E-00	0.335436E-00	0.305158E-00
40	0.723672E-00	0.645157E-00	0.577443E-00	0.518753E-00	0.467648E-00	0.422954E-00	0.383707E-00	0.349111E-00
41	0.829376E-00	0.739538E-00	0.662038E-00	0.594850E-00	0.536331E-00	0.485142E-00	0.440182E-00	0.400541E-00
42	0.953459E-00	0.850359E-00	0.761393E-00	0.694244E-00	0.617033E-00	0.558227E-00	0.5056564E-00	0.461005E-00
43	0.109983E-01	0.981122E-00	0.878658E-00	0.794779E-00	0.712328E-00	0.644545E-00	0.584983E-00	0.532446E-00
44	0.127338E-01	0.113621E-01	0.101778E-01	0.915016E-01	0.825441E-00	0.747027E-00	0.678105E-00	0.617297E-00
45	0.148019E-01	0.1321C9E-01	0.118366E-01	0.106439E-01	0.960385E-00	0.869316E-00	0.789251E-00	0.718593E-00
46	0.202633E-01	0.180954E-01	0.162216E-01	0.145941E-01	0.131742E-01	0.119300E-01	0.108359E-01	0.986907E-00
47	0.282552E-01	0.252484E-01	0.226475E-01	0.203867E-01	0.184128E-01	0.166820E-01	0.151585E-01	0.138123E-01
48	0.401290E-01	0.358843E-01	0.322093E-01	0.290123E-01	0.262187E-01	0.237674E-01	0.216079E-01	0.196986E-01
49	0.579277E-01	0.518407E-01	0.465568E-01	0.419729E-01	0.379560E-01	0.344284E-01	0.313183E-01	0.285664E-01
50	0.699520E-01	0.626271E-01	0.562764E-01	0.507744E-01	0.459037E-01	0.416509E-01	0.379000E-01	0.345798E-01
51	0.846824E-01	0.758468E-01	0.681826E-01	0.615031E-01	0.556561E-01	0.505167E-01	0.459820E-01	0.419663E-01
52	0.102699E-02	0.920232E-01	0.827580E-01	0.746793E-01	0.676043E-01	0.613828E-01	0.558890E-01	0.510255E-01
53	0.124689E-02	0.111776E-02	0.100563E-02	0.971818E-01	0.822111E-01	0.746723E-01	0.680141E-01	0.621131E-01
54	0.151462E-02	0.135835E-02	0.122260E-02	0.110412E-02	0.100026E-02	0.908856E-01	0.828099E-01	0.756495E-01
55	0.18947E-02	0.165040E-02	0.148609E-02	0.134261E-02	0.121678E-02	0.110599E-02	0.100806E-02	0.921199E-01
56	0.223238E-02	0.200381E-02	0.180507E-02	0.163144E-02	0.147911E-02	0.134492E-02	0.122626E-02	0.112097E-02
57	0.270620E-02	0.243018E-02	0.219006E-02	0.198020E-02	0.179599E-02	0.163365E-02	0.149004E-02	0.136255E-02
58	0.327549E-02	0.294270E-02	0.265305E-02	0.239978E-02	0.217738E-02	0.198129E-02	0.180776E-02	0.165364E-02
59	0.395690E-02	0.355642E-02	0.320770E-02	0.290265E-02	0.263465E-02	0.239826E-02	0.218898E-02	0.200303E-02
60	0.476968E-02	0.428879E-02	0.386986E-02	0.350324E-02	0.318101E-02	0.289666E-02	0.264481E-02	0.242097E-02
61	0.573542E-02	0.515937E-02	0.465733E-02	0.41778E-02	0.383129E-02	0.349010E-02	0.318775E-02	0.291896E-02
62	0.687843E-02	0.619022E-02	0.559017E-02	0.506458E-02	0.460225E-02	0.419394E-02	0.383200E-02	0.351005E-02
63	0.822601E-02	0.740610E-02	0.669092E-02	0.616422E-02	0.551273E-02	0.502548E-02	0.459339E-02	0.420890E-02
64	0.980822E-02	0.883431E-02	0.798644E-02	0.739462E-02	0.658353E-02	0.600383E-02	0.548955E-02	0.503175E-02
65	0.116587E-03	0.105054E-03	0.949857E-02	0.861562E-02	0.783799E-02	0.715042E-02	0.654022E-02	0.599682E-02
66	0.1613056E-03	0.147047E-03	0.133059E-03	0.120783E-03	0.109963E-03	0.100389E-03	0.918856E-02	0.843079E-02
67	0.191934E-03	0.173159E-03	0.156749E-03	0.142342E-03	0.129638E-03	0.118393E-03	0.108402E-03	0.994958E-02
68	0.225160E-03	0.203216E-03	0.184029E-03	0.167177E-03	0.152312E-03	0.139150E-03	0.127451E-03	0.117019E-03

NU=	0.250000E-00	0.625000E-01	0.706019E-01	0.787037E-01	0.868056E-01	0.949074E-01	0.103009E-00	0.111111E-00
1	0.	TAUNU						
2	0.254180E-07	0.286681E-06	0.210139E-06	0.158528E-06	0.122436E-06	0.964349E-07	0.772343E-07	0.627544E-07
3	0.254177E-05	0.286687E-04	0.210144E-04	0.158532E-04	0.122439E-04	0.964375E-05	0.772364E-05	0.627562E-05
4	0.254034E-03	0.287032E-02	0.210418E-02	0.158753E-02	0.122620E-02	0.965873E-03	0.773617E-03	0.628619E-03
5	0.402492E-03	0.455214E-02	0.333727E-02	0.251797E-02	0.194495E-02	0.153210E-02	0.122718E-02	0.997207E-03
6	0.637636E-03	0.722139E-02	0.529455E-02	0.399502E-02	0.308607E-02	0.243113E-02	0.194739E-02	0.158252E-02
7	0.100998E-02	0.114603E-01	0.840331E-02	0.634138E-02	0.489902E-02	0.385965E-02	0.309190E-02	0.251277E-02
8	0.159939E-02	0.181975E-01	0.133454E-01	0.10723E-01	0.778230E-02	0.613194E-02	0.491272E-02	0.399292E-02
9	0.253207E-02	0.289174E-01	0.212116E-01	0.160123E-01	0.123741E-01	0.975155E-02	0.781381E-02	0.635170E-02
10	0.318552E-02	0.364670E-01	0.267531E-01	0.201980E-01	0.156105E-01	0.123033E-01	0.985948E-02	0.801529E-02
11	0.400722E-02	0.460008E-01	0.337527E-01	0.254863E-01	0.197004E-01	0.155287E-01	0.124455E-01	0.101186E-01
12	0.504049E-02	0.580476E-01	0.425998E-01	0.391721E-01	0.248723E-01	0.196082E-01	0.157171E-01	0.127801E-01
13	0.633965E-02	0.732778E-01	0.537885E-01	0.406300E-01	0.314167E-01	0.247716E-01	0.198589E-01	0.161501E-01
14	0.797327E-02	0.925475E-01	0.679499E-01	0.513387E-01	0.397054E-01	0.313131E-01	0.251075E-01	0.204218E-01
15	0.100274E-01	0.116945E-00	0.858874E-01	0.649080E-01	0.502119E-01	0.396076E-01	0.317646E-01	0.258412E-01
16	0.126109E-01	0.147865E-00	0.108631E-00	0.871203E-01	0.635445E-01	0.501370E-01	0.402181E-01	0.327251E-01
17	0.158612E-01	0.187094E-00	0.137501E-00	0.103979E-00	0.804839E-01	0.635203E-01	0.509670E-01	0.414812E-01
18	0.199527E-01	0.236929E-00	0.174179E-00	0.111779E-00	0.102038E-00	0.805569E-01	0.646557E-01	0.526363E-01
19	0.251073E-01	0.300336E-00	0.220917E-00	0.147194E-00	0.129510E-00	0.102283E-00	0.821200E-01	0.668743E-01
20	0.281689E-01	0.338294E-00	0.248899E-00	0.188414E-00	0.145979E-00	0.115312E-00	0.925974E-01	0.754190E-01
21	0.316086E-01	0.381174E-00	0.280521E-00	0.212404E-00	0.164602E-00	0.130049E-00	0.104452E-00	0.850892E-01
22	0.354746E-01	0.429642E-00	0.316278E-00	0.239540E-00	0.185675E-00	0.146731E-00	0.117874E-00	0.960405E-01
23	0.398222E-01	0.484468E-00	0.356741E-00	0.270258E-00	0.209537E-00	0.165627E-00	0.133081E-00	0.108452E-00
24	0.447147E-01	0.546538E-00	0.402569E-00	0.305062E-00	0.236584E-00	0.187051E-00	0.150329E-00	0.122533E-00
25	0.502424E-01	0.616864E-00	0.454515E-00	0.344529E-00	0.267265E-00	0.211362E-00	0.169907E-00	0.138921E-00
26	0.564633E-01	0.696629E-00	0.513460E-00	0.399330E-00	0.302107E-00	0.238980E-00	0.192156E-00	0.156696E-00
27	0.634379E-01	0.787201E-00	0.580420E-00	0.440247E-00	0.341720E-00	0.270391E-00	0.217469E-00	0.177380E-00
28	0.713486E-01	0.890166E-00	0.656580E-00	0.498184E-00	0.386814E-00	0.306163E-00	0.246307E-00	0.200952E-00
29	0.802944E-01	0.100740E-01	0.743339E-00	0.564211E-00	0.438226E-00	0.346962E-00	0.279210E-00	0.227857E-00
30	0.904247E-01	0.114107E-01	0.842305E-00	0.679573E-00	0.496933E-00	0.393571E-00	0.316812E-00	0.258615E-00
31	0.101916E-00	0.129377E-01	0.955425E-00	0.775751E-00	0.564098E-00	0.446917E-00	0.359868E-00	0.293847E-00
32	0.114975E-00	0.146855E-01	0.108497E-01	0.874496E-00	0.641094E-01	0.508099E-00	0.409268E-00	0.334286E-00
33	0.129847E-00	0.166904E-01	0.123367E-01	0.977892E-00	0.729557E-00	0.578426E-00	0.466076E-00	0.380809E-00
34	0.146824E-00	0.189961E-01	0.140476E-01	0.106844E-01	0.831456E-00	0.659473E-00	0.531574E-00	0.434470E-00
35	0.166255E-00	0.216547E-01	0.160216E-01	0.171916E-01	0.949156E-00	0.753136E-00	0.607302E-00	0.496541E-00
36	0.188560E-00	0.247297E-01	0.183062E-01	0.179368E-01	0.108553E-01	0.861712E-00	0.695132E-00	0.568562E-00
37	0.214247E-00	0.282979E-01	0.209590E-01	0.159646E-01	0.124406E-01	0.988003E-00	0.797342E-00	0.652415E-00
38	0.243933E-00	0.324536E-01	0.240506E-01	0.193293E-01	0.142905E-01	0.113544E-01	0.916731E-00	0.750411E-00
39	0.278375E-00	0.373124E-01	0.276677E-01	0.210977E-01	0.164575E-01	0.130826E-01	0.105675E-01	0.865359E-00
40	0.318053E-00	0.430174E-01	0.319178E-01	0.243527E-01	0.190070E-01	0.151171E-01	0.122167E-01	0.100090E-01
41	0.365464E-00	0.497446E-01	0.369343E-01	0.291973E-01	0.220203E-01	0.175232E-01	0.141683E-01	0.116134E-01
42	0.420683E-00	0.557720E-01	0.428837E-01	0.377602E-01	0.255990E-01	0.203824E-01	0.164888E-01	0.135222E-01
43	0.485937E-00	0.672181E-01	0.499750E-01	0.392028E-01	0.298705E-01	0.237976E-01	0.192622E-01	0.158049E-01
44	0.563455E-00	0.785891E-01	0.584719E-01	0.447291E-01	0.349963E-01	0.278984E-01	0.225946E-01	0.185493E-01
45	0.656015E-00	0.922724E-01	0.687049E-01	0.525950E-01	0.411787E-01	0.328481E-01	0.266195E-01	0.218660E-01
46	0.901270E-00	0.128964E-02	0.961809E-01	0.773741E-01	0.578195E-01	0.461860E-01	0.374771E-01	0.308226E-01
47	0.126188E-01	0.183731E-02	0.137264E-02	0.105414E-02	0.827282E-01	0.662251E-01	0.538134E-01	0.443172E-01
48	0.180045E-01	0.266704E-02	0.199618E-02	0.153568E-02	0.120800E-02	0.967911E-01	0.787691E-01	0.649618E-01
49	0.261230E-01	0.393443E-02	0.295036E-02	0.277385E-02	0.179175E-02	0.143801E-02	0.117210E-02	0.968085E-01
50	0.316306E-01	0.480185E-02	0.360425E-02	0.278034E-02	0.219277E-02	0.176132E-02	0.143677E-02	0.118759E-02
51	0.383980E-01	0.587372E-02	0.441300E-02	0.340732E-02	0.268959E-02	0.216220E-02	0.176518E-02	0.146016E-02
52	0.467006E-01	0.719576E-02	0.541137E-02	0.418197E-02	0.330394E-02	0.265829E-02	0.217191E-02	0.179797E-02
53	0.568654E-01	0.882236E-02	0.664408E-02	0.513670E-02	0.406172E-02	0.327069E-02	0.267437E-02	0.221560E-02
54	0.692794E-01	0.108181E-03	0.815054E-02	0.61006E-02	0.499376E-02	0.402450E-02	0.329333E-02	0.273043E-02
55	0.843891E-01	0.132576E-03	0.999751E-02	0.774668E-02	0.613582E-02	0.494885E-02	0.405286E-02	0.336262E-02
56	0.102722E-02	0.162292E-03	0.122492E-03	0.949950E-02	0.753030E-02	0.607836E-02	0.498164E-02	0.413623E-02
57	0.124900E-02	0.198373E-03	0.149854E-03	0.116311E-03	0.922742E-02	0.745400E-02	0.611362E-02	0.507973E-02
58	0.151631E-02	0.242011E-03	0.182972E-03	0.142131E-03	0.112847E-03	0.912278E-02	0.748777E-02	0.622587E-02
59	0.183728E-02	0.294571E-03	0.222892E-03	0.173279E-03	0.137682E-03	0.111387E-03	0.914895E-02	0.761232E-02
60	0.222135E-02	0.357646E-03	0.270835E-03	0.210713E-03	0.167552E-03	0.135650E-03	0.111496E-03	0.928322E-02
61	0.267915E-02	0.433029E-03	0.328177E-03	0.255519E-03	0.203328E-03	0.164732E-03	0.135492E-03	0.112886E-03
62	0.322273E-02	0.522752E-03	0.396576E-03	0.308924E-03	0.246001E-03	0.199442E-03	0.164151E-03	0.136852E-03
63	0.386563E-02	0.629106E-03	0.477493E-03	0.372318E-03	0.296689E-03	0.240700E-03	0.198238E-03	0.165376E-03
64	0.462288E-02	0.754625E-03	0.573177E-03	0.447240E-03	0.356636E-03	0.289526E-03	0.238604E-03	0.199174E-03
65	0.551134E-02	0.902160E-03	0.685720E-03	0.535423E-03	0.427240E-03	0.347068E-03	0.286206E-03	0.239055E-03
66	0.775329E-02	0.127533E-04	0.970675E-03	0.758922E-03	0.606358E-03	0.493191E-03	0.407198E-03	0.340517E-03
67	0.915300E-02	0.150878E-04	0.114911E-04	0.899007E-03	0.718730E-03	0.584945E-03	0.483240E-03	0.404338E-03
68	0.107685E-03	0.177852E-04	0.135542E-04	0.106108E-04	0.848816E-03	0.691226E-03	0.571372E-03	0.478350E-03

NU#	0.400000E-01	0.437500E-01	0.475000E-01	0.512500E-01	0.550000E-01	0.587500E-01	0.625000E-01	0.277778E-01
1	0.	0.	0.	0.	0.	0.	0.	0.
2	0.445610E-06	0.359957E-06	0.295240E-06	0.245331E-06	0.206164E-06	0.174959E-06	0.149770E-06	0.737121E-06
3	0.445627E-04	0.359971E-04	0.295252E-04	0.245341E-04	0.206172E-04	0.174967E-04	0.149776E-04	0.737154E-04
4	0.446594E-02	0.360773E-02	0.295926E-02	0.245915E-02	0.206665E-02	0.175394E-02	0.150149E-02	0.739114E-02
5	0.708639E-02	0.572480E-02	0.469594E-02	0.390244E-02	0.327968E-02	0.278350E-02	0.238293E-02	0.117311E-01
6	0.112500E-01	0.908880E-02	0.745569E-02	0.619612E-02	0.520754E-02	0.441987E-02	0.378395E-02	0.186306E-01
7	0.178723E-01	0.144399E-01	0.118460E-01	0.944533E-02	0.827500E-02	0.702374E-02	0.601351E-02	0.296134E-01
8	0.284211E-01	0.229648E-01	0.188412E-01	0.156604E-01	0.131636E-01	0.111740E-01	0.956759E-02	0.471273E-01
9	0.452569E-01	0.365731E-01	0.300096E-01	0.249463E-01	0.209714E-01	0.178037E-01	0.152457E-01	0.751227E-01
10	0.571474E-01	0.461858E-01	0.379002E-01	0.315079E-01	0.264894E-01	0.224898E-01	0.192598E-01	0.949231E-01
11	0.721984E-01	0.583553E-01	0.478908E-01	0.398170E-01	0.334780E-01	0.284254E-01	0.243449E-01	0.120016E-00
12	0.912677E-01	0.737763E-01	0.605529E-01	0.503495E-01	0.423379E-01	0.359516E-01	0.307935E-01	0.151852E-00
13	0.115450E-00	0.933359E-01	0.766161E-01	0.637713E-01	0.535814E-01	0.455041E-01	0.389797E-01	0.192286E-00
14	0.146152E-00	0.118174E-00	0.970186E-01	0.876911E-01	0.678680E-01	0.576443E-01	0.493852E-01	0.243712E-00
15	0.185176E-00	0.149752E-00	0.122963E-00	0.172285E-00	0.860435E-01	0.730924E-01	0.626287E-01	0.309203E-00
16	0.234846E-00	0.189957E-00	0.156004E-00	0.127972E-00	0.109201E-00	0.927799E-01	0.795104E-01	0.392745E-00
17	0.298165E-00	0.241224E-00	0.198148E-00	0.164889E-00	0.138756E-00	0.117912E-00	0.101067E-00	0.499499E-00
18	0.379026E-00	0.306716E-00	0.252003E-00	0.209751E-00	0.176547E-00	0.150058E-00	0.128645E-00	0.636191E-00
19	0.482501E-00	0.390554E-00	0.320970E-00	0.247221E-00	0.224974E-00	0.191263E-00	0.164008E-00	0.811618E-00
20	0.544726E-00	0.440985E-00	0.362467E-00	0.318181E-00	0.254128E-00	0.216076E-00	0.185308E-00	0.917355E-00
21	0.615248E-00	0.498153E-00	0.409516E-00	0.341034E-00	0.287195E-00	0.244225E-00	0.209476E-00	0.103738E-01
22	0.695230E-00	0.563002E-00	0.462289E-00	0.385548E-00	0.324729E-00	0.276181E-00	0.236918E-00	0.117375E-01
23	0.786016E-00	0.636628E-00	0.523518E-00	0.436108E-00	0.367369E-00	0.312493E-00	0.268106E-00	0.132880E-01
24	0.889168E-00	0.720302E-00	0.592427E-00	0.479359E-00	0.415860E-00	0.353796E-00	0.303587E-00	0.150529E-01
25	0.100646E-01	0.815482E-00	0.670830E-00	0.559013E-00	0.471056E-00	0.400820E-00	0.343993E-00	0.170638E-01
26	0.114004E-01	0.923880E-00	0.760142E-00	0.637355E-00	0.533962E-00	0.454425E-00	0.390062E-00	0.193578E-01
27	0.129230E-01	0.104748E-01	0.862008E-00	0.718591E-00	0.605745E-00	0.515607E-00	0.442655E-00	0.219781E-01
28	0.146611E-01	0.118861E-01	0.978348E-00	0.815738E-00	0.687769E-00	0.585534E-00	0.502780E-00	0.249754E-01
29	0.166483E-01	0.135010E-01	0.111144E-01	0.976898E-00	0.781649E-00	0.665590E-00	0.571629E-00	0.284095E-01
30	0.189240E-01	0.153491E-01	0.126394E-01	0.105431E-01	0.889278E-00	0.757393E-00	0.650602E-00	0.323509E-01
31	0.215352E-01	0.174712E-01	0.143902E-01	0.120063E-01	0.101292E-01	0.862280E-00	0.741369E-00	0.368836E-01
32	0.245378E-01	0.199121E-01	0.164047E-01	0.136902E-01	0.115525E-01	0.984349E-00	0.845915E-00	0.421075E-01
33	0.279982E-01	0.227261E-01	0.187277E-01	0.146327E-01	0.131948E-01	0.112455E-01	0.966617E-00	0.481423E-01
34	0.319968E-01	0.259788E-01	0.214138E-01	0.178794E-01	0.150950E-01	0.128680E-01	0.110634E-01	0.551324E-01
35	0.366304E-01	0.297493E-01	0.245284E-01	0.214855E-01	0.172997E-01	0.147512E-01	0.126856E-01	0.632528E-01
36	0.420167E-01	0.341338E-01	0.281515E-01	0.235179E-01	0.198659E-01	0.169438E-01	0.145750E-01	0.727163E-01
37	0.482994E-01	0.392497E-01	0.323805E-01	0.270587E-01	0.228633E-01	0.195057E-01	0.167831E-01	0.837834E-01
38	0.556552E-01	0.452416E-01	0.373353E-01	0.312086E-01	0.263775E-01	0.225103E-01	0.193737E-01	0.967753E-01
39	0.643020E-01	0.522287E-01	0.431641E-01	0.360922E-01	0.305144E-01	0.260485E-01	0.224255E-01	0.112089E-02
40	0.745111E-01	0.606103E-01	0.500511E-01	0.418646E-01	0.354060E-01	0.302335E-01	0.260363E-01	0.130220E-02
41	0.866206E-01	0.704859E-01	0.582265E-01	0.471974E-01	0.412170E-01	0.352070E-01	0.303289E-01	0.151787E-02
42	0.101054E-02	0.822615E-01	0.679787E-01	0.568994E-01	0.481541E-01	0.411464E-01	0.354570E-01	0.177568E-02
43	0.118346E-02	0.963749E-01	0.796718E-01	0.667113E-01	0.564782E-01	0.482761E-01	0.416151E-01	0.208545E-02
44	0.139173E-02	0.113381E-02	0.937672E-02	0.785439E-01	0.665206E-01	0.568808E-01	0.490501E-01	0.245968E-02
45	0.164389E-02	0.133397E-02	0.110847E-02	0.978878E-01	0.786994E-01	0.673203E-01	0.580739E-01	0.291415E-02
46	0.232665E-02	0.189792E-02	0.157159E-02	0.171807E-02	0.111766E-02	0.956827E-01	0.826057E-01	0.415077E-02
47	0.335883E-02	0.274247E-02	0.227300E-02	0.190805E-02	0.161935E-02	0.138751E-02	0.119888E-02	0.603224E-02
48	0.494286E-02	0.403977E-02	0.335144E-02	0.281597E-02	0.239209E-02	0.205147E-02	0.177414E-02	0.893834E-02
49	0.739344E-02	0.604865E-02	0.502295E-02	0.472448E-02	0.359198E-02	0.308335E-02	0.266895E-02	0.134630E-03
50	0.908564E-02	0.743678E-02	0.617872E-02	0.519903E-02	0.442270E-02	0.379820E-02	0.328922E-02	0.166014E-03
51	0.111895E-03	0.916133E-02	0.761696E-02	0.641229E-02	0.545736E-02	0.468893E-02	0.406242E-02	0.205151E-03
52	0.137998E-03	0.113066E-03	0.940304E-02	0.791965E-02	0.674338E-02	0.579652E-02	0.502427E-02	0.253856E-03
53	0.170303E-03	0.139601E-03	0.116153E-03	0.978751E-02	0.833764E-02	0.717016E-02	0.621766E-02	0.314304E-03
54	0.210162E-03	0.172357E-03	0.143474E-03	0.170982E-03	0.127340E-03	0.103081E-03	0.886867E-02	0.769389E-02
55	0.259153E-03	0.212633E-03	0.177082E-03	0.149351E-03	0.127340E-03	0.109605E-03	0.951272E-02	0.481289E-03
56	0.319149E-03	0.261978E-03	0.218273E-03	0.184172E-03	0.157097E-03	0.135275E-03	0.117455E-03	0.594485E-03
57	0.392375E-03	0.322229E-03	0.268588E-03	0.276723E-03	0.193474E-03	0.166668E-03	0.144771E-03	0.733003E-03
58	0.481388E-03	0.395497E-03	0.329799E-03	0.278508E-03	0.237762E-03	0.204902E-03	0.178053E-03	0.901809E-03
59	0.589130E-03	0.484217E-03	0.403946E-03	0.341262E-03	0.291451E-03	0.251269E-03	0.218428E-03	0.110664E-04
60	0.719049E-03	0.591239E-03	0.493423E-03	0.417018E-03	0.356287E-03	0.307284E-03	0.267222E-03	0.135422E-04
61	0.875052E-03	0.719795E-03	0.600944E-03	0.508084E-03	0.434255E-03	0.375667E-03	0.325940E-03	0.165221F-04
62	0.106158E-04	0.873562E-03	0.729597E-03	0.617086E-03	0.527612E-03	0.455379E-03	0.396296E-03	0.200932E-04
63	0.128367E-04	0.105671E-04	0.882885E-03	0.747007E-03	0.638923E-03	0.551646E-03	0.480241E-03	0.243545E-04
64	0.154692E-04	0.127388E-04	0.106471E-04	0.991167E-03	0.771047E-03	0.665951E-03	0.579948E-03	0.294167E-04
65	0.185765E-04	0.153030E-04	0.127948E-04	0.108332E-04	0.927214E-03	0.801101E-03	0.697875E-03	0.354045E-04
66	0.264852E-04	0.218328E-04	0.182665E-04	0.154762E-04	0.132547E-04	0.114593E-04	0.998907E-03	0.506917E-04
67	0.314616E-04	0.259435E-04	0.217127E-04	0.184019E-04	0.157654E-04	0.136342E-04	0.118886E-04	0.603390E-04
68	0.372336E-04	0.307129E-04	0.257124E-04	0.217985E-04	0.186811E-04	0.161606E-04	0.140958E-04	0.715498E-04

NU=	0.308333E-01	0.338889E-01	0.369444E-01	0.400000E-01	0.204082E-01	0.240930E-01	0.277778E-01	0.156250E-01
1	0.	0.	0.	0.	0.	0.	0.	0.
2	0.580976E-06	0.467200E-06	0.382021E-06	0.316800E-06	0.120197E-05	0.831647E-06	0.603623E-06	0.189534E-05
3	0.581003E-04	0.467222E-04	0.382040E-04	0.316815E-04	0.120203E-03	0.831690E-04	0.603655E-04	0.189544E-03
4	0.582579E-02	0.468513E-02	0.383115E-02	0.317723E-02	0.120556E-01	0.834189E-02	0.605509E-02	0.190133E-01
5	0.924668E-02	0.743659E-02	0.608126E-02	0.594341E-02	0.191373E-01	0.132426E-01	0.961268E-02	0.301849E-01
6	0.146859E-01	0.118113E-01	0.969509E-02	0.810909E-02	0.303992E-01	0.210367E-01	0.152711E-01	0.479544E-01
7	0.233447E-01	0.187762E-01	0.153557E-01	0.127362E-01	0.483341E-01	0.334504E-01	0.242843E-01	0.762607E-01
8	0.371542E-01	0.298857E-01	0.244432E-01	0.202750E-01	0.769525E-01	0.532618E-01	0.386709E-01	0.121446E-00
9	0.592319E-01	0.476497E-01	0.389764E-01	0.373334E-01	0.122738E-00	0.849641E-01	0.616197E-01	0.193776E-00
10	0.748495E-01	0.602177E-01	0.492602E-01	0.478672E-01	0.151517E-00	0.107409E-00	0.780032E-01	0.245000E-00
11	0.946442E-01	0.761149E-01	0.622978E-01	0.516876E-01	0.196247E-00	0.135878E-00	0.986883E-01	0.309987E-00
12	0.119762E-00	0.963677E-00	0.788459E-01	0.654233E-01	0.248431E-00	0.172031E-00	0.124962E-00	0.392539E-00
13	0.151668E-00	0.122056E-00	0.998741E-01	0.828804E-01	0.314767E-00	0.217998E-00	0.158375E-00	0.497537E-00
14	0.192256E-00	0.154739E-00	0.126634E-00	0.175100E-00	0.399219E-00	0.276534E-00	0.200934E-00	0.631290E-00
15	0.243957E-00	0.196380E-00	0.160734E-00	0.133420E-00	0.506890E-00	0.351184E-00	0.255223E-00	0.801934E-00
16	0.309923E-00	0.249522E-00	0.202464E-00	0.149580E-00	0.644406E-00	0.446555E-00	0.324603E-00	0.102040E-01
17	0.394242E-00	0.317467E-00	0.259933E-00	0.215835E-00	0.802037E-00	0.568636E-00	0.413443E-00	0.129937E-01
18	0.502238E-00	0.404518E-00	0.331276E-00	0.275130E-00	0.104602E-01	0.725246E-00	0.527453E-00	0.165791E-01
19	0.640883E-00	0.516309E-00	0.422924E-00	0.351323E-00	0.133690E-01	0.926648E-00	0.674131E-00	0.211927E-01
20	0.724471E-00	0.583724E-00	0.478205E-00	0.397294E-00	0.151111E-01	0.104824E-01	0.762711E-00	0.239793E-01
21	0.819377E-00	0.660281E-00	0.540994E-00	0.449517E-00	0.171007E-01	0.118643E-01	0.8633406E-00	0.271473E-01
22	0.927215E-00	0.747286E-00	0.612366E-00	0.578889E-00	0.193626E-01	0.134360E-01	0.977965E-00	0.307519E-01
23	0.104986E-01	0.846257E-00	0.693568E-00	0.576451E-00	0.219372E-01	0.152255E-01	0.110842E-01	0.348573E-01
24	0.118949E-01	0.958959E-00	0.786054E-00	0.653417E-00	0.248707E-01	0.172650E-01	0.125715E-01	0.395380E-01
25	0.134862E-01	0.108742E-01	0.891498E-00	0.741184E-00	0.282166E-01	0.195919E-01	0.142687E-01	0.448802E-01
26	0.153019E-01	0.123404E-01	0.101186E-01	0.841393E-00	0.320277E-01	0.222500E-01	0.162081E-01	0.509854E-01
27	0.173764E-01	0.140159E-01	0.114945E-01	0.955959E-00	0.364074E-01	0.252909E-01	0.184272E-01	0.579179E-01
28	0.197498E-01	0.159333E-01	0.130693E-01	0.108713E-01	0.414111E-01	0.287736E-01	0.209700E-01	0.659784E-01
29	0.224699E-01	0.181312E-01	0.148750E-01	0.127356E-01	0.471519E-01	0.327704E-01	0.238887E-01	0.751698E-01
30	0.255926E-01	0.206551E-01	0.169490E-01	0.141038E-01	0.537483E-01	0.373647E-01	0.272448E-01	0.857399E-01
31	0.291846E-01	0.235591E-01	0.193359E-01	0.160933E-01	0.613439E-01	0.426567E-01	0.311111E-01	0.979207E-01
32	0.333255E-01	0.269077E-01	0.220890E-01	0.173885E-01	0.701093E-01	0.487657E-01	0.355773E-01	0.111989E-02
33	0.381106E-01	0.307783E-01	0.252721E-01	0.210429E-01	0.802487E-01	0.558349E-01	0.407464E-01	0.128275E-02
34	0.436547E-01	0.352642E-01	0.289622E-01	0.242120E-01	0.920095E-01	0.640374E-01	0.467464E-01	0.147182E-02
35	0.500972E-01	0.404078E-01	0.332526E-01	0.277008E-01	0.105691E-02	0.735831E-01	0.537313E-01	0.169196E-02
36	0.576075E-01	0.465586E-01	0.382971E-01	0.318777E-01	0.121658E-02	0.847279E-01	0.618894E-01	0.194911E-02
37	0.663932E-01	0.536736E-01	0.441150E-01	0.367682E-01	0.140359E-02	0.977854E-01	0.714514E-01	0.225055E-02
38	0.767102E-01	0.620231E-01	0.509982E-01	0.425164E-01	0.162345E-02	0.113143E-02	0.827023E-01	0.260527E-02
39	0.888751E-01	0.718891E-01	0.591194E-01	0.493006E-01	0.188301E-02	0.131281E-02	0.959951E-01	0.302443E-02
40	0.103282E-02	0.835680E-01	0.687439E-01	0.573431E-01	0.219079E-02	0.152798E-02	0.111771E-02	0.352196E-02
41	0.120426E-02	0.974697E-01	0.802041E-01	0.669228E-01	0.255749E-02	0.178445E-02	0.130583E-02	0.411532E-02
42	0.140927E-02	0.114099E-02	0.939176E-02	0.783898E-02	0.299655E-02	0.209167E-02	0.153127E-02	0.482648E-02
43	0.165569E-02	0.134095E-02	0.110141E-02	0.971878E-01	0.352500E-02	0.246160E-02	0.180284E-02	0.568331E-02
44	0.195349E-02	0.158269E-02	0.130362E-02	0.108881E-02	0.416449E-02	0.290947E-02	0.213179E-02	0.672127E-02
45	0.231528E-02	0.187648E-02	0.154616E-02	0.129183E-02	0.494244E-02	0.345457E-02	0.253233E-02	0.798530E-02
46	0.330031E-02	0.267687E-02	0.220730E-02	0.194557E-02	0.706513E-02	0.494304E-02	0.362688E-02	0.114402E-03
47	0.480021E-02	0.389656E-02	0.321558E-02	0.246907E-02	0.103064E-03	0.721817E-02	0.530154E-02	0.167276E-03
48	0.711883E-02	0.578354E-02	0.477762E-02	0.400027E-02	0.153312E-03	0.107487E-03	0.790288E-02	0.249426E-03
49	0.107317E-03	0.872622E-02	0.721320E-02	0.674571E-02	0.231827E-03	0.162710E-03	0.119758E-03	0.378076E-03
50	0.132391E-03	0.107696E-03	0.890605E-03	0.746765E-02	0.286423E-03	0.201137E-03	0.148120E-03	0.4667673E-03
51	0.163637E-03	0.133199E-03	0.110196E-03	0.974364E-03	0.354626E-03	0.249164E-03	0.183584E-03	0.579717E-03
52	0.202615E-03	0.164960E-03	0.136528E-03	0.114571E-03	0.439643E-03	0.309061E-03	0.227833E-03	0.719529E-03
53	0.250967E-03	0.204409E-03	0.169247E-03	0.142085E-03	0.545333E-03	0.383557E-03	0.282894E-03	0.893516E-03
54	0.310819E-03	0.253260E-03	0.209777E-03	0.176179E-03	0.676324E-03	0.475929E-03	0.351197E-03	0.110936E-04
55	0.384610E-03	0.313508E-03	0.259782E-03	0.219285E-03	0.838011E-03	0.589997E-03	0.435580E-03	0.137604E-04
56	0.475251E-03	0.387540E-03	0.321247E-03	0.270000E-03	0.103685E-04	0.730336E-03	0.539443E-03	0.170430E-04
57	0.586207E-03	0.478196E-03	0.396540E-03	0.333402E-03	0.128052E-04	0.902394E-03	0.666834E-03	0.210695E-04
58	0.721470E-03	0.588748E-03	0.488389E-03	0.410770E-03	0.157790E-04	0.111246E-04	0.822431E-03	0.259878E-04
59	0.885652E-03	0.722980E-03	0.599947E-03	0.574771E-03	0.193925E-04	0.136782E-04	0.101165E-04	0.319690E-04
60	0.108417E-04	0.885335E-03	0.734920E-03	0.618537E-03	0.237661E-04	0.167701E-04	0.124085E-04	0.392145E-04
61	0.132317E-04	0.108086E-04	0.897522E-03	0.759563E-03	0.290370E-04	0.204979E-04	0.151729E-04	0.479537E-04
62	0.160969E-04	0.131533E-04	0.109256E-04	0.970131E-04	0.353618E-04	0.249727E-04	0.184926E-04	0.584485E-04
63	0.195168E-04	0.159529E-04	0.132552E-04	0.111666E-04	0.429187E-04	0.303212E-04	0.224618E-04	0.709973E-04
64	0.235807E-04	0.192804E-04	0.160246E-04	0.115039E-04	0.519065E-04	0.366847E-04	0.271860E-04	0.859336E-04
65	0.283890E-04	0.232188E-04	0.193038E-04	0.152717E-04	0.625506E-04	0.442236E-04	0.327848E-04	0.103635E-05
66	0.406703E-04	0.332822E-04	0.276859E-04	0.2733502E-04	0.897732E-04	0.635147E-04	0.471187E-04	0.148957E-05
67	0.484236E-04	0.396378E-04	0.329818E-04	0.278242E-04	0.106980E-05	0.757144E-04	0.561879E-04	0.177633E-05
68	0.574360E-04	0.470275E-04	0.391409E-04	0.330287E-04	0.126998E-05	0.899113E-04	0.667451E-04	0.211015E-05

NU=	0.180166E-01	0.204082E-01	0.123457E-01	0.139853E-01	0.156250E-01	0.100000E-01	0.111728E-01	0.123457E-01
1	0.	0.	0.	0.	0.	0.	0.	0.
2	0.139164E-05	0.105901E-05	0.288275E-05	0.270914E-05	0.174063E-05	0.423910E-05	0.335504E-05	0.271500E-05
3	0.139171E-03	0.105907E-03	0.288291E-03	0.270926E-03	0.174072E-03	0.423934E-03	0.335523E-03	0.271515E-03
4	0.139610E-01	0.106246E-01	0.289219E-01	0.271645E-01	0.174644E-01	0.425332E-01	0.336638E-01	0.272424E-01
5	0.221646E-01	0.168681E-01	0.459184E-01	0.351904E-01	0.277287E-01	0.675315E-01	0.534499E-01	0.432548E-01
6	0.352139E-01	0.26800CE-01	0.729562E-01	0.559128E-01	0.440582E-01	0.107302E-00	0.849291E-01	0.687308E-01
7	0.560262E-01	0.426236E-01	0.116035E-00	0.894308E-01	0.700782E-01	0.170675E-00	0.135092E-00	0.109329E-00
8	0.891913E-01	0.678883E-01	0.184819E-00	0.141655E-00	0.111631E-00	0.271882E-00	0.215207E-00	0.174172E-00
9	0.142325E-00	0.108342E-00	0.294962E-00	0.226091E-00	0.178183E-00	0.433984E-00	0.343536E-00	0.278046E-00
10	0.179960E-00	0.136999E-00	0.372993E-00	0.295915E-00	0.225340E-00	0.548851E-00	0.434477E-00	0.351661E-00
11	0.227712E-00	0.173364E-00	0.472015E-00	0.341839E-00	0.285193E-00	0.694467E-00	0.549912E-00	0.445110E-00
12	0.288378E-00	0.219570E-00	0.597841E-00	0.498323E-00	0.361262E-00	0.879948E-00	0.696634E-00	0.563896E-00
13	0.365551E-00	0.278356E-00	0.757936E-00	0.591097E-00	0.458067E-00	0.111577E-01	0.883377E-00	0.715092E-00
14	0.463875E-00	0.353267E-00	0.961957E-00	0.773757E-00	0.581462E-00	0.141639E-01	0.112144E-01	0.907860E-00
15	0.589342E-00	0.448875E-00	0.122237E-01	0.977332E-00	0.739005E-00	0.180021E-01	0.142544E-01	0.115403E-01
16	0.749742E-00	0.571127E-00	0.155538E-01	0.119282E-01	0.940530E-01	0.229121E-01	0.181436E-01	0.146901E-01
17	0.955213E-00	0.727767E-00	0.198210E-01	0.152025E-01	0.119885E-01	0.292062E-01	0.231297E-01	0.187288E-01
18	0.121901E-01	0.928924E-01	0.253016E-01	0.194086E-01	0.153073E-01	0.372934E-01	0.295372E-01	0.239194E-01
19	0.155856E-01	0.118791E-01	0.323586E-01	0.248255E-01	0.195825E-01	0.477116E-01	0.377927E-01	0.306080E-01
20	0.176369E-01	0.134441E-01	0.366233E-01	0.290997E-01	0.221669E-01	0.540098E-01	0.427840E-01	0.346525E-01
21	0.199694E-01	0.152239E-01	0.414735E-01	0.318238E-01	0.251068E-01	0.611747E-01	0.484627E-01	0.392543E-01
22	0.226238E-01	0.174294E-01	0.469944E-01	0.360632E-01	0.284539E-01	0.693324E-01	0.549287E-01	0.444945E-01
23	0.256474E-01	0.195575E-01	0.532846E-01	0.409894E-01	0.322684E-01	0.786295E-01	0.622986E-01	0.504677E-01
24	0.290954E-01	0.221897E-01	0.604594E-01	0.464050E-01	0.366204E-01	0.892371E-01	0.707080E-01	0.572842E-01
25	0.330314E-01	0.251595E-01	0.686519E-01	0.576983E-01	0.415909E-01	0.101353E-02	0.803140E-01	0.650712E-01
26	0.375304E-01	0.286310E-01	0.780184E-01	0.508945E-01	0.472753E-01	0.115209E-02	0.913011E-01	0.739788E-01
27	0.426798E-01	0.325644E-01	0.887420E-01	0.691345E-01	0.537851E-01	0.131078E-02	0.103885E-02	0.841821E-01
28	0.485823E-01	0.370739E-01	0.101037E-02	0.775833E-01	0.612509E-01	0.149279E-02	0.118320E-02	0.958869E-01
29	0.553596E-01	0.422529E-01	0.115159E-02	0.894374E-01	0.698283E-01	0.170190E-02	0.134906E-02	0.109338E-02
30	0.631553E-01	0.482112E-01	0.131406E-02	0.1070928E-02	0.797001E-01	0.194258E-02	0.153998E-02	0.124823E-02
31	0.721408E-01	0.550806E-01	0.150140E-02	0.115331E-02	0.910857E-01	0.222018E-02	0.176022E-02	0.142687E-02
32	0.825208E-01	0.630178E-01	0.171787E-02	0.121977E-02	0.104246E-02	0.254107E-02	0.201483E-02	0.163342E-02
33	0.945408E-01	0.722111E-01	0.196861E-02	0.151262E-02	0.119496E-02	0.291292E-02	0.230990E-02	0.187283E-02
34	0.108498E-02	0.828897E-01	0.225987E-02	0.173666E-02	0.137219E-02	0.334500E-02	0.265281E-02	0.215108E-02
35	0.124753E-02	0.953270E-01	0.259911E-02	0.199771E-02	0.157864E-02	0.384856E-02	0.305251E-02	0.247546E-02
36	0.143745E-02	0.109864E-02	0.299575E-02	0.210288E-02	0.182008E-02	0.443736E-02	0.351992E-02	0.285483E-02
37	0.166014E-02	0.126913E-02	0.346091E-02	0.266089E-02	0.210337E-02	0.512827E-02	0.406846E-02	0.330011E-02
38	0.192227E-02	0.146987E-02	0.400864E-02	0.382825E-02	0.243707E-02	0.594216E-02	0.471473E-02	0.382480E-02
39	0.223212E-02	0.170720E-02	0.465626E-02	0.358116E-02	0.281371E-02	0.690492E-02	0.547932E-02	0.444562E-02
40	0.259997E-02	0.198907E-02	0.542546E-02	0.417351E-02	0.330077E-02	0.804890E-02	0.638795E-02	0.518352E-02
41	0.308811E-02	0.232541E-02	0.634341E-02	0.498056E-02	0.386069E-02	0.941472E-02	0.747295E-02	0.606476E-02
42	0.356493E-02	0.272877E-02	0.744434E-02	0.572872E-02	0.453249E-02	0.110536E-03	0.877502E-02	0.712248E-02
43	0.419901E-02	0.321504E-02	0.877166E-02	0.675152E-02	0.534278E-02	0.130303E-03	0.103458E-03	0.839869E-02
44	0.496737E-02	0.380467E-02	0.103807E-03	0.799165E-02	0.632546E-02	0.154278E-03	0.122512E-03	0.994697E-02
45	0.590338E-02	0.452273E-02	0.123416E-03	0.950329E-02	0.752355E-02	0.183509E-03	0.145747E-03	0.118353E-03
46	0.846302E-02	0.648789E-02	0.177071E-03	0.166411E-03	0.108042E-03	0.263557E-03	0.209392E-03	0.170091E-03
47	0.123829E-03	0.949931E-02	0.259305E-03	0.199857E-03	0.158369E-03	0.386364E-03	0.307067E-03	0.249520E-03
48	0.184773E-03	0.141845E-03	0.387261E-03	0.298626E-03	0.236750E-03	0.577649E-03	0.459258E-03	0.373321E-03
49	0.280278E-03	0.215315E-03	0.587939E-03	0.453601E-03	0.359794E-03	0.877951E-03	0.698265E-03	0.567810E-03
50	0.346822E-03	0.266530E-03	0.727841E-03	0.561677E-03	0.445629E-03	0.108745E-04	0.865044E-03	0.703556E-03
51	0.430065E-03	0.330617E-03	0.902916E-03	0.696953E-03	0.553091E-03	0.134975E-04	0.107389E-04	0.873567E-03
52	0.533971E-03	0.410638E-03	0.112153E-04	0.865908E-03	0.687337E-03	0.167743E-04	0.133483E-04	0.108602E-04
53	0.663316E-03	0.510279E-03	0.139375E-04	0.107635E-04	0.854579E-03	0.208566E-04	0.165997E-04	0.135079E-04
54	0.823828E-03	0.633969E-03	0.173170E-04	0.137364E-04	0.106228E-04	0.259267E-04	0.206384E-04	0.167972E-04
55	0.102220E-04	0.786879E-03	0.214949E-04	0.166073E-04	0.131916E-04	0.321975E-04	0.256343E-04	0.208666E-04
56	0.126645E-04	0.975206E-03	0.266640E-04	0.205876E-04	0.163568E-04	0.399242E-04	0.317911E-04	0.258824E-04
57	0.156614E-04	0.120634E-04	0.329564E-04	0.254737E-04	0.202431E-04	0.494114E-04	0.393516E-04	0.320427E-04
58	0.193229E-04	0.148882E-04	0.406753E-04	0.314465E-04	0.249946E-04	0.610111E-04	0.485970E-04	0.395767E-04
59	0.237771E-04	0.183253E-04	0.500677E-04	0.397156E-04	0.307785E-04	0.751313E-04	0.598528E-04	0.487502E-04
60	0.291741E-04	0.224911E-04	0.614517E-04	0.475277E-04	0.377913E-04	0.922520E-04	0.735022E-04	0.598761E-04
61	0.356855E-04	0.275182E-04	0.751899E-04	0.571641E-04	0.462573E-04	0.112921E-05	0.899825E-04	0.733111E-04
62	0.435068E-04	0.335583E-04	0.916965E-04	0.709460E-04	0.564329E-04	0.137764E-05	0.109793E-05	0.894634E-04
63	0.528612E-04	0.407841E-04	0.111444E-05	0.862399E-04	0.686104E-04	0.167495E-05	0.1133505E-05	0.108798E-05
64	0.639980E-04	0.493887E-04	0.134960E-05	0.104456E-05	0.831166E-04	0.202911E-05	0.161755E-05	0.131836E-05
65	0.771998E-04	0.595911E-04	0.162843E-05	0.126058E-05	0.100322E-05	0.244920E-05	0.195266E-05	0.159169E-05
66	0.111012E-05	0.857304E-04	0.234284E-05	0.181418E-05	0.144427E-05	0.352603E-05	0.281183E-05	0.229255E-05
67	0.132413E-05	0.102280E-05	0.279516E-05	0.216477E-05	0.172364E-05	0.420814E-05	0.335614E-05	0.273665E-05
68	0.157331E-05	0.121553E-05	0.332193E-05	0.297313E-05	0.204908E-05	0.500275E-05	0.399031E-05	0.325410E-05

NU=	0.10000E 01	0.10000E 01	0.10000E 01	0.25000E-00	0.291667E-00	0.333333E-00	0.375000E-00	0.416667E-00
	BNU	BNU	BNU	BNU	BNU	BNU	BNU	BNU
1	0.262051E-09	0.262051E-09	0.262051E-C9	0.39545E-04	0.252703E-04	0.154354E-04	0.899910E-05	0.505611E-05
2	0.262056E-09	0.262056E-09	0.262056E-C9	0.395457E-04	0.252705E-04	0.154355E-04	0.899918E-05	0.505616E-05
3	0.262448E-09	0.262448E-09	0.262448E-09	0.396963E-04	0.252815E-04	0.154432E-04	0.900422E-05	0.505931E-05
4	0.286325E-09	0.286325E-09	0.286325E-09	0.398311E-04	0.259331E-04	0.158983E-04	0.930318E-05	0.524625E-05
5	0.298440E-09	0.298440E-09	0.298440E-09	0.402480E-04	0.262491E-04	0.161197E-04	0.944895E-05	0.533765E-05
6	0.316710E-09	0.316710E-09	0.316710E-09	0.408533E-04	0.267089E-04	0.164424E-04	0.966192E-05	0.547146E-05
7	0.344498E-09	0.344498E-09	0.344498E-C9	0.417257E-04	0.273735E-04	0.169103E-04	0.997160E-05	0.566662E-05
8	0.387333E-09	0.387333E-09	0.387333E-09	0.429729E-04	0.283275E-04	0.175846E-04	0.104198E-04	0.595024E-05
9	0.454671E-09	0.454671E-09	0.454671E-09	0.447394E-04	0.296863E-04	0.185506E-04	0.110656E-04	0.636129E-05
10	0.502339E-09	0.502339E-09	0.502339E-09	0.458749E-04	0.305643E-04	0.191781E-04	0.114873E-04	0.663116E-05
11	0.563345E-09	0.563345E-09	0.563345E-09	0.472161E-04	0.316059E-04	0.199257E-04	0.119920E-04	0.695559E-05
12	0.642146E-09	0.642146E-09	0.642146E-09	0.497964E-04	0.328392E-04	0.208155E-04	0.125957E-04	0.734564E-05
13	0.744973E-09	0.744973E-09	0.744973E-09	0.506539E-04	0.342970E-04	0.218732E-04	0.133176E-04	0.781471E-05
14	0.880682E-09	0.880682E-09	0.880682E-09	0.528320E-04	0.360173E-04	0.231295E-04	0.141806E-04	0.837919E-05
15	0.106199E-08	0.106199E-08	0.106199E-08	0.553805E-04	0.380445E-04	0.246207E-04	0.152124E-04	0.905912E-05
16	0.130749E-08	0.130749E-08	0.130749E-08	0.593569E-04	0.404309E-04	0.263904E-04	0.164470E-04	0.987931E-05
17	0.164466E-08	0.164466E-08	0.164466E-08	0.618279E-04	0.432382E-04	0.284909E-04	0.179256E-04	0.108706E-04
18	0.211486E-08	0.211486E-08	0.211486E-08	0.658716E-04	0.465403E-04	0.309858E-04	0.196994E-C4	0.120718E-04
19	0.278122E-08	0.278122E-08	0.278122E-08	0.705803E-04	0.504258E-04	0.339532E-04	0.218320E-04	0.135317E-04
20	0.321645E-08	0.321645E-08	0.321645E-08	0.732162E-04	0.526189E-04	0.356422E-04	0.230564E-04	0.143770E-04
21	0.374099E-08	0.374099E-08	0.374099E-08	0.760605E-04	0.549993E-04	0.374865E-04	0.244015E-04	0.155115E-04
22	0.437593E-08	0.437593E-08	0.437593E-08	0.791300E-04	0.575839E-04	0.395017E-04	0.258804E-04	0.163455E-04
23	0.514798E-08	0.514798E-08	0.514798E-08	0.827443E-04	0.603915E-04	0.417049E-04	0.275080E-04	0.174909E-04
24	0.609108E-08	0.609108E-08	0.609108E-08	0.860218E-04	0.634433E-04	0.441157E-04	0.293011E-04	0.187616E-04
25	0.724836E-08	0.724836E-08	0.724836E-08	0.889887E-04	0.667621E-04	0.467556E-04	0.312784E-04	0.201726E-04
26	0.867515E-08	0.867515E-08	0.867515E-08	0.904644E-04	0.703737E-04	0.496490E-04	0.334612E-04	0.217418E-04
27	0.104425E-07	0.104425E-07	0.104425E-07	0.948581E-04	0.743066E-04	0.528230E-04	0.358738E-04	0.233489E-04
28	0.126421E-07	0.126421E-07	0.126421E-07	0.103467E-03	0.785928E-04	0.563084E-04	0.385434E-04	0.254377E-04
29	0.153931E-07	0.153931E-07	0.153931E-07	0.108757E-03	0.832678E-04	0.601396E-04	0.415012E-04	0.276142E-04
30	0.188501E-07	0.188501E-07	0.188501E-07	0.114486E-03	0.883708E-04	0.643552E-04	0.447825E-04	0.300484E-04
31	0.232155E-07	0.232155E-07	0.232155E-07	0.120696E-03	0.939463E-04	0.689989E-04	0.484272E-04	0.327753E-04
32	0.287554E-07	0.287554E-07	0.287554E-07	0.177432E-03	0.100044E-03	0.741201E-04	0.524815E-04	0.358350E-04
33	0.358197E-07	0.358197E-07	0.358197E-07	0.174744E-03	0.106717E-03	0.797743E-04	0.569971E-04	0.392733E-04
34	0.448728E-07	0.448728E-07	0.448728E-07	0.142689E-03	0.114030E-03	0.860246E-04	0.620340E-04	0.431437E-04
35	0.565326E-07	0.565326E-07	0.565326E-07	0.151328E-03	0.122052E-03	0.929426E-04	0.676606E-04	0.475079E-04
36	0.716311E-07	0.716311E-07	0.716311E-07	0.160734E-03	0.130864E-03	0.100613E-03	0.739581E-04	0.524392E-04
37	0.912816E-07	0.912816E-07	0.912816E-07	0.170986E-03	0.140555E-03	0.109128E-03	0.810171E-04	0.580213E-04
38	0.116987E-06	0.116987E-06	0.116987E-06	0.120696E-03	0.151226E-03	0.118594E-03	0.889422E-04	0.643512E-04
39	0.150784E-06	0.150784E-06	0.150784E-06	0.194386E-03	0.162990E-03	0.129113E-03	0.978540E-04	0.715423E-04
40	0.195480E-06	0.195480E-06	0.195480E-06	0.207751E-03	0.175984E-03	0.140890E-03	0.107899E-03	0.797325E-04
41	0.254876E-06	0.254876E-06	0.254876E-06	0.222384E-03	0.190350E-03	0.154021E-03	0.119235E-03	0.890743E-04
42	0.334243E-06	0.334243E-06	0.334243E-06	0.238432E-03	0.206260E-03	0.167814E-03	0.132055E-03	0.997539E-04
43	0.440708E-06	0.440708E-06	0.440708E-06	0.256030E-03	0.223881E-03	0.1815159E-03	0.146559E-03	0.111971E-03
44	0.584360E-06	0.584360E-06	0.584360E-06	0.275369E-03	0.243443E-03	0.203608E-03	0.163012E-03	0.125985E-03
45	0.778388E-06	0.778388E-06	0.778388E-06	0.296571E-03	0.265108E-03	0.224262E-03	0.181636E-03	0.142031E-03
46	0.140076E-05	0.140076E-05	0.140076E-05	0.345471E-03	0.315865E-03	0.273462E-03	0.226774E-03	0.181616E-03
47	0.255896E-05	0.255896E-05	0.255896E-05	0.404404E-03	0.378320E-03	0.335345E-03	0.284861E-03	0.233770E-03
48	0.468348E-05	0.468348E-05	0.468348E-05	0.474191E-03	0.453796E-03	0.411782E-03	0.358270E-03	0.301253E-03
49	0.849677E-05	0.849677E-05	0.849677E-05	0.555488E-03	0.543489E-03	0.504568E-03	0.449391E-03	0.386979E-03
50	0.113747E-04	0.113747E-04	0.113747E-04	0.670588E-03	0.593954E-03	0.555752E-03	0.502282E-03	0.437568E-03
51	0.151296E-04	0.151296E-04	0.151296E-04	0.684849E-03	0.648047E-03	0.614950E-03	0.560137E-03	0.493510E-03
52	0.200016E-04	0.200016E-04	0.200016E-04	0.697936E-03	0.705997E-03	0.677005E-03	0.623343E-03	0.555572E-03
53	0.262590E-04	0.262590E-04	0.262590E-04	0.731282E-03	0.767768E-03	0.743761E-03	0.692002E-03	0.623050E-03
54	0.342586E-04	0.342586E-04	0.342586E-04	0.810098E-03	0.833648E-03	0.815588E-03	0.766575E-03	0.697392E-03
55	0.442366E-04	0.442366E-04	0.442366E-04	0.869121E-03	0.902642E-03	0.891447E-03	0.846043E-03	0.777367E-03
56	0.569279E-04	0.569279E-04	0.569279E-04	0.972113E-03	0.976711E-03	0.973546E-03	0.932794E-03	0.865468E-03
57	0.727400E-04	0.727400E-04	0.727400E-04	0.998176E-03	0.105494E-02	0.106094E-02	0.102591E-02	0.960870E-03
58	0.923917E-04	0.923917E-04	0.923917E-04	0.1076767E-02	0.113780E-02	0.115418E-02	0.112607E-02	0.106435E-02
59	0.116459E-03	0.116459E-03	0.116459E-03	0.116401E-02	0.122473E-02	0.125272E-02	0.123272E-02	0.117544E-02
60	0.146404E-03	0.146404E-03	0.146404E-03	0.171718E-02	0.131779E-02	0.135983E-02	0.134852E-02	0.129702E-02
61	0.182553E-03	0.182553E-03	0.182553E-03	0.179710E-02	0.141488E-02	0.147046E-02	0.147100E-02	0.142658E-02
62	0.226878E-03	0.226878E-03	0.226878E-03	0.178171E-02	0.151825E-02	0.158995E-02	0.160312E-02	0.156735E-02
63	0.280076E-03	0.280076E-03	0.280076E-03	0.166977E-02	0.162641E-02	0.171575E-02	0.174311E-02	0.171756E-02
64	0.344252E-03	0.344252E-03	0.344252E-03	0.156233E-02	0.174069E-02	0.184943E-02	0.189282E-02	0.187927E-02
65	0.420936E-03	0.420936E-03	0.420936E-03	0.156911E-02	0.186078E-02	0.199068E-02	0.205196E-02	0.205228E-02
66	0.619605E-03	0.619605E-03	0.619605E-03	0.186555E-02	0.211875E-02	0.229650E-02	0.239947E-02	0.243356E-02
67	0.746525E-03	0.746525E-03	0.746525E-03	0.197580E-02	0.225742E-02	0.246209E-02	0.258913E-02	0.264344E-02
68	0.895144E-03	0.895144E-03	0.895144E-03	0.209075E-02	0.240259E-02	0.263624E-02	0.278961E-02	0.286649E-02

NU=	0.458333E-00	0.500000E-00	0.541667E 00	0.593333E 00	0.625000E 00	0.666667E 00	0.708333E 00	0.750000E 00
	BNU							
1	0.275669E-05	0.146612E-05	0.763619E-06	0.390712E-06	0.196867E-06	0.978786E-07	0.480953E-07	0.233884E-07
2	0.275672E-05	0.146613E-05	0.763629E-06	0.390717E-06	0.196870E-06	0.978800E-07	0.480960E-07	0.233888E-07
3	0.275861E-05	0.146723E-05	0.764247E-06	0.391058E-06	0.197054E-06	0.979776E-07	0.481470E-07	0.234151E-07
4	0.287093E-05	0.153252E-05	0.801156E-06	0.411434E-06	0.208075E-06	0.103833E-06	0.512100E-07	0.249952E-07
5	0.292599E-05	0.156461E-05	0.819344E-06	0.421501E-06	0.213535E-06	0.106742E-06	0.527356E-07	0.257843E-07
6	0.300677E-05	0.161179E-05	0.846143E-06	0.436367E-06	0.221614E-06	0.111055E-06	0.550024E-07	0.269593E-07
7	0.312494E-05	0.168101E-05	0.885581E-06	0.458308E-06	0.233574E-06	0.117460E-06	0.583785E-07	0.287146E-07
8	0.329740E-05	0.178246E-05	0.943623E-06	0.490737E-06	0.251325E-06	0.127005E-06	0.634317E-07	0.313528E-07
9	0.354879E-05	0.193120E-05	0.102921E-05	0.538836E-06	0.277808E-06	0.141328E-06	0.710584E-07	0.353578E-07
10	0.371473E-05	0.202992E-05	0.108633E-05	0.557110E-06	0.295669E-06	0.151041E-06	0.762581E-07	0.381031E-07
11	0.391511E-05	0.214965E-05	0.115591E-05	0.610593E-06	0.317627E-06	0.163035E-06	0.827075E-07	0.415234E-07
12	0.415725E-05	0.229508E-05	0.124086E-05	0.659052E-06	0.344711E-06	0.177904E-06	0.907445E-07	0.458076E-07
13	0.445015E-05	0.247202E-05	0.134948E-05	0.718702E-06	0.378243E-06	0.196423E-06	0.100812E-06	0.512056E-07
14	0.480495E-05	0.268778E-05	0.147242E-05	0.792401E-06	0.419948E-06	0.219606E-06	0.113499E-06	0.580533E-07
15	0.523547E-05	0.295152E-05	0.162957E-05	0.883836E-06	0.472074E-06	0.248797E-06	0.129593E-06	0.668042E-07
16	0.575910E-05	0.327496E-05	0.182387E-05	0.997830E-06	0.537598E-06	0.285796E-06	0.150161E-06	0.780801E-07
17	0.639777E-05	0.367307E-05	0.206522E-05	0.114072E-05	0.620487E-06	0.333030E-06	0.176658E-06	0.927407E-07
18	0.717939E-05	0.416519E-05	0.236658E-05	0.120945E-05	0.726082E-06	0.393809E-06	0.211100E-06	0.111989E-06
19	0.813985E-05	0.477656E-05	0.274509E-05	0.154980E-05	0.861653E-06	0.472704E-06	0.256299E-06	0.137527E-06
20	0.870083E-05	0.513675E-05	0.297002E-05	0.168697E-05	0.943618E-06	0.520815E-06	0.284101E-06	0.153372E-06
21	0.932475E-05	0.553983E-05	0.322329E-05	0.194239E-05	0.103706E-05	0.576001E-06	0.316188E-06	0.171772E-06
22	0.100196E-04	0.599197E-05	0.350987E-05	0.201882E-05	0.114381E-05	0.639459E-06	0.353323E-06	0.193204E-06
23	0.107944E-04	0.649871E-05	0.383181E-05	0.221953E-05	0.126607E-05	0.712618E-06	0.396421E-06	0.218243E-06
24	0.116598E-04	0.706903E-05	0.419739E-05	0.244838E-05	0.140644E-05	0.797119E-06	0.446587E-06	0.247590E-06
25	0.126277E-04	0.771146E-05	0.461213E-05	0.270987E-05	0.156797E-05	0.895212E-06	0.505146E-06	0.282093E-06
26	0.137120E-04	0.843666E-05	0.508363E-05	0.309394E-05	0.175433E-05	0.100914E-05	0.573711E-06	0.322790E-06
27	0.149286E-04	0.925611E-05	0.562076E-05	0.315310E-05	0.196988E-05	0.114192E-05	0.654234E-06	0.370950E-06
28	0.162959E-04	0.101846E-04	0.623398E-05	0.374864E-05	0.221987E-05	0.129712E-05	0.749094E-06	0.428132E-06
29	0.178354E-04	0.112384E-04	0.693556E-05	0.472048E-05	0.251055E-05	0.147906E-05	0.861198E-06	0.496257E-06
30	0.195715E-04	0.124367E-04	0.774014E-05	0.473241E-05	0.284946E-05	0.169295E-05	0.994096E-06	0.577694E-06
31	0.215333E-04	0.138021E-04	0.866475E-05	0.534388E-05	0.324567E-05	0.194516E-05	0.115215E-05	0.675379E-06
32	0.237532E-04	0.153613E-04	0.972982E-05	0.605546E-05	0.371017E-05	0.224345E-05	0.134073E-05	0.792963E-06
33	0.262706E-04	0.171451E-04	0.109594E-04	0.698225E-05	0.425621E-05	0.259728E-05	0.156646E-05	0.934987E-06
34	0.291305E-04	0.191904E-04	0.123823E-04	0.784910E-05	0.489991E-05	0.301829E-05	0.183755E-05	0.110714E-05
35	0.323857E-04	0.215406E-04	0.140330E-04	0.898136E-05	0.566094E-05	0.352079E-05	0.216419E-05	0.131655E-05
36	0.360997E-04	0.242481E-04	0.159531E-04	0.1n3114E-04	0.656361E-05	0.412265E-05	0.255927E-05	0.157232E-05
37	0.404345E-04	0.273740E-04	0.181921E-04	0.118778E-04	0.763743E-05	0.484581E-05	0.303872E-05	0.188583E-05
38	0.452087E-04	0.309912E-04	0.208096E-04	0.137278E-04	0.891861E-05	0.571747E-05	0.362257E-05	0.2271153E-05
39	0.507910E-04	0.351865E-04	0.238770E-04	0.159185E-04	0.104517E-04	0.677151E-05	0.433601E-05	0.274779E-05
40	0.572216E-04	0.400666E-04	0.274835E-04	0.185218E-04	0.122931E-04	0.805109E-05	0.521142E-05	0.333846E-05
41	0.646240E-04	0.457544E-04	0.317327E-04	0.216228E-04	0.145106E-04	0.960896E-05	0.628893E-05	0.407349E-05
42	0.731860E-04	0.524015E-04	0.367541E-04	0.253283E-04	0.171901E-04	0.115125E-04	0.762033E-05	0.499192E-05
43	0.830190E-04	0.601782E-04	0.426957E-04	0.297629E-04	0.204336E-04	0.138432E-04	0.926916E-05	0.614238E-05
44	0.945827E-04	0.693049E-04	0.497498E-04	0.350892E-04	0.243747E-04	0.167082E-04	0.113198E-04	0.758991E-05
45	0.107894E-03	0.800005E-04	0.581140E-04	0.414795E-04	0.291594E-04	0.202279E-04	0.138689E-04	0.941081E-05
46	0.141330E-03	0.107364E-03	0.799117E-04	0.584457E-04	0.421019E-04	0.299288E-04	0.210282E-04	0.146222E-04
47	0.186451E-03	0.145197E-03	0.110796E-03	0.830830E-04	0.613661E-04	0.447297E-04	0.322253E-04	0.229775E-04
48	0.246258E-03	0.196584E-03	0.153739E-03	0.118246E-03	0.895547E-04	0.669361E-04	0.494513E-04	0.361582E-04
49	0.324055E-03	0.265057E-03	0.212501E-03	0.167451E-03	0.129987E-03	0.995878E-04	0.754713E-04	0.565273E-04
50	0.370750E-03	0.306873E-03	0.248984E-03	0.198572E-03	0.156016E-03	0.120982E-03	0.927357E-04	0.703556E-04
51	0.422967E-03	0.354170E-03	0.290731E-03	0.234603E-03	0.186508E-03	0.146346E-03	0.113513E-03	0.871454E-04
52	0.481246E-03	0.407548E-03	0.338381E-03	0.276201E-03	0.222121E-03	0.176314E-03	0.138349E-03	0.107451E-03
53	0.545878E-03	0.467387E-03	0.392388E-03	0.323875E-03	0.263393E-03	0.211442E-03	0.167794E-03	0.131799E-03
54	0.617497E-03	0.534391E-03	0.453510E-03	0.378417E-03	0.311135E-03	0.252520E-03	0.202609E-03	0.160910E-03
55	0.695299E-03	0.607916E-03	0.521272E-03	0.439518E-03	0.365181E-03	0.299522E-03	0.242874E-03	0.194941E-03
56	0.781820E-03	0.690480E-03	0.598125E-03	0.509520E-03	0.427738E-03	0.354490E-03	0.290453E-03	0.235577E-03
57	0.876374E-03	0.781154E-03	0.683734E-03	0.582676E-03	0.498815E-03	0.417577E-03	0.345618E-03	0.283173E-03
58	0.979845E-03	0.882153E-03	0.779162E-03	0.676888E-03	0.579581E-03	0.489967E-03	0.409544E-03	0.338878E-03
59	0.109187E-02	0.992019E-03	0.884337E-03	0.775546E-03	0.670262E-03	0.572016E-03	0.482693E-03	0.403235E-03
60	0.121548E-02	0.111428E-02	0.100241E-02	0.887118E-03	0.773913E-03	0.666668E-03	0.567868E-03	0.478878E-03
61	0.134825E-02	0.124669E-02	0.111313E-02	0.101013E-02	0.889115E-03	0.772813E-03	0.664251E-03	0.565258E-03
62	0.149326E-02	0.139281E-02	0.127483E-02	0.114813E-02	0.101947E-02	0.893970E-03	0.775236E-03	0.666509E-03
63	0.164987E-02	0.155108E-02	0.143148E-02	0.130004E-02	0.116416E-02	0.102958E-02	0.900520E-03	0.779870E-03
64	0.181928E-02	0.172395E-02	0.160388E-02	0.146854E-02	0.132593E-02	0.118244E-02	0.104292E-02	0.910831E-03
65	0.200176E-02	0.191148E-02	0.179229E-02	0.165609E-02	0.150547E-02	0.135344E-02	0.120350E-02	0.105971E-02
66	0.240788E-02	0.233314E-02	0.222044E-02	0.208042E-02	0.192265E-02	0.175538E-02	0.158540E-02	0.141803E-02
67	0.263346E-02	0.256958E-02	0.246291E-02	0.232431E-02	0.216382E-02	0.199023E-02	0.181097E-02	0.163200E-02
68	0.287457E-02	0.282385E-02	0.272531E-02	0.259000E-02	0.242831E-02	0.224958E-02	0.206183E-02	0.187168E-02

NU=	0.791667E 00	0.833333E 00	0.875000E 00	0.916667E 00	0.958333E 00	1.000000E 00	0.111111E-00	0.118827E-00
	BNU	BNU	BNU	BNU	BNU	BNU	BNU	BNU
1	0.112687E-07	0.538431E-08	0.255344E-08	0.170272E-08	0.562999E-09	0.262051E-09	0.734592E-04	0.749983E-04
2	0.112689E-07	0.538441E-08	0.255349E-08	0.170274E-08	0.563012E-09	0.262057E-09	0.734594E-04	0.749985E-04
3	0.112822E-07	0.539112E-08	0.255683E-08	0.170439E-08	0.563818E-09	0.262449E-09	0.734729E-04	0.750130E-04
4	0.120873E-07	0.579684E-08	0.275925E-08	0.130446E-08	0.612884E-09	0.286326E-09	0.742608E-04	0.758603E-04
5	0.124905E-07	0.600054E-08	0.286114E-08	0.135497E-08	0.637716E-09	0.298441E-09	0.746391E-04	0.762673E-04
6	0.130921E-07	0.630513E-08	0.301382E-08	0.143082E-08	0.675028E-09	0.316711E-09	0.751851E-04	0.768548E-04
7	0.139934E-07	0.676287E-08	0.324397E-08	0.154549E-08	0.731744E-09	0.344499E-09	0.759654E-04	0.776948E-04
8	0.153539E-07	0.745669E-08	0.359429E-08	0.170277E-08	0.818722E-09	0.387334E-09	0.770677E-04	0.788819E-04
9	0.174312E-07	0.852230E-08	0.413547E-08	0.199312E-08	0.954661E-09	0.454673E-09	0.786037E-04	0.8035375E-04
10	0.188628E-07	0.926062E-08	0.451244E-08	0.218386E-08	0.105037E-08	0.502340E-09	0.795761E-04	0.819862E-04
11	0.206545E-07	0.101888E-07	0.498846E-08	0.242580E-08	0.117232E-08	0.563347E-09	0.807103E-04	0.828102E-04
12	0.229101E-07	0.113633E-07	0.559395E-08	0.273511E-08	0.132904E-08	0.642148E-09	0.820277E-04	0.842327E-04
13	0.257689E-07	0.128605E-07	0.637033E-08	0.313406E-08	0.153235E-08	0.744975E-09	0.835510E-04	0.858788E-04
14	0.294193E-07	0.147851E-07	0.737490E-08	0.363567E-08	0.179890E-08	0.880685E-09	0.853049E-04	0.877756E-04
15	0.341191E-07	0.172813E-07	0.868751E-08	0.433767E-08	0.215240E-08	0.106200E-08	0.873153E-04	0.899517E-04
16	0.402251E-07	0.205513E-07	0.104213E-07	0.574862E-08	0.262709E-08	0.130749E-08	0.896103E-04	0.924384E-04
17	0.482368E-07	0.248813E-07	0.127381E-07	0.647712E-08	0.327312E-08	0.164467E-08	0.922204E-04	0.952695E-04
18	0.588616E-07	0.306815E-07	0.158730E-07	0.815617E-08	0.416502E-08	0.211487E-08	0.951786E-04	0.984821E-04
19	0.731146E-07	0.385483E-07	0.201718E-07	0.104840E-07	0.541520E-08	0.278123E-08	0.985222E-04	0.102118E-03
20	0.820335E-07	0.435134E-07	0.229084E-07	0.119786E-07	0.622479E-08	0.321646E-08	0.100350E-03	0.104108E-03
21	0.924554E-07	0.493512E-07	0.261456E-07	0.137578E-07	0.719451E-08	0.374100E-08	0.102290E-03	0.106221E-03
22	0.104672E-06	0.562386E-07	0.299899E-07	0.158840E-07	0.836080E-08	0.437594E-08	0.104348E-03	0.108464E-03
23	0.119041E-06	0.643931E-07	0.345717E-07	0.184351E-07	0.976953E-08	0.514799E-08	0.106530E-03	0.110845E-03
24	0.135999E-06	0.740834E-06	0.400541E-07	0.215087E-07	0.114786E-07	0.609110E-08	0.108844E-03	0.113371E-03
25	0.156078E-06	0.856397E-07	0.466389E-07	0.252269E-07	0.135608E-07	0.724837E-08	0.111297E-03	0.116051E-03
26	0.179937E-06	0.994733E-07	0.545579E-07	0.297439E-07	0.161019E-07	0.867517E-08	0.113896E-03	0.118893E-03
27	0.208387E-06	0.116054E-06	0.641935E-07	0.352544E-07	0.192416E-07	0.104425E-07	0.116651E-03	0.121908E-03
28	0.24242433E-06	0.136142E-06	0.758806E-07	0.470061E-07	0.231099E-07	0.126421E-07	0.119571E-03	0.125107E-03
29	0.283324E-06	0.160416E-06	0.901464E-07	0.530144E-07	0.279088E-07	0.153931E-07	0.122666E-03	0.128500E-03
30	0.332614E-06	0.189920E-06	0.107631E-06	0.658526E-07	0.338894E-07	0.188501E-07	0.125947E-03	0.132101E-03
31	0.392247E-06	0.225922E-06	0.129150E-06	0.733288E-07	0.413771E-07	0.232156E-07	0.129426E-03	0.135923E-03
32	0.466663E-06	0.270028E-06	0.155747E-06	0.872217E-07	0.507958E-07	0.287554E-07	0.133116E-03	0.139980E-03
33	0.552924E-06	0.324273E-06	0.188754E-06	0.109125E-06	0.626983E-07	0.358198E-07	0.137031E-03	0.144288E-03
34	0.660904E-06	0.391257E-06	0.229892E-06	0.134162E-06	0.778107E-07	0.448729E-07	0.141186E-03	0.148866E-03
35	0.793516E-06	0.474346E-06	0.281385E-06	0.158500E-06	0.970901E-07	0.565327E-07	0.145599E-03	0.153731E-03
36	0.957064E-06	0.577734E-06	0.346141E-06	0.259578E-06	0.121813E-06	0.716312E-07	0.150289E-03	0.158908E-03
37	0.115955E-05	0.707070E-06	0.427932E-06	0.257234E-06	0.153670E-06	0.912818E-07	0.155277E-03	0.164419E-03
38	0.141122E-05	0.869474E-06	0.531690E-06	0.372926E-06	0.194918E-06	0.116987E-06	0.160585E-03	0.170290E-03
39	0.172524E-05	0.107425E-05	0.663895E-06	0.470508E-06	0.245857E-06	0.150784E-06	0.166238E-03	0.176549E-03
40	0.211890E-05	0.133371E-05	0.833210E-06	0.516998E-06	0.318808E-06	0.195481E-06	0.172267E-03	0.183231E-03
41	0.261416E-05	0.166374E-05	0.105094E-05	0.593945E-06	0.411106E-06	0.254867E-06	0.178700E-03	0.190368E-03
42	0.323995E-05	0.208543E-05	0.133228E-05	0.845347E-06	0.533066E-06	0.334243E-06	0.185573E-03	0.198001E-03
43	0.403283E-05	0.262586E-05	0.169696E-05	0.108922E-05	0.694810E-06	0.440708E-06	0.192914E-03	0.206163E-03
44	0.504213E-05	0.332185E-05	0.217213E-05	0.1410170E-05	0.910522E-06	0.584361E-06	0.200770E-03	0.214907E-03
45	0.632690E-05	0.421837E-05	0.279150E-05	0.193474E-05	0.119845E-05	0.778389E-06	0.209157E-03	0.224251E-03
46	0.100741E-04	0.688316E-05	0.466780E-05	0.314399E-05	0.210453E-05	0.140076E-05	0.227729E-03	0.244977E-03
47	0.162328E-04	0.113730E-04	0.790864E-05	0.564226E-05	0.374930E-05	0.255896E-05	0.248950E-03	0.268709E-03
48	0.261954E-04	0.188208E-04	0.134214E-04	0.950616E-05	0.669143E-05	0.468348E-05	0.272795E-03	0.295430E-03
49	0.419799E-04	0.309190E-04	0.226025E-04	0.164111E-04	0.118421E-04	0.849678E-05	0.299216E-03	0.325096E-03
50	0.528873E-04	0.394283E-04	0.291753E-04	0.214423E-04	0.156617E-04	0.113747E-04	0.313362E-03	0.341001E-03
51	0.662901E-04	0.500103E-04	0.374475E-04	0.278508E-04	0.205856E-04	0.151296E-04	0.328050E-03	0.357530E-03
52	0.826897E-04	0.631111E-04	0.478095E-04	0.359730E-04	0.268999E-04	0.200016E-04	0.343312E-03	0.374719E-03
53	0.102581E-03	0.791835E-04	0.606684E-04	0.461684E-04	0.349173E-04	0.262590E-04	0.359110E-03	0.392526E-03
54	0.126629E-03	0.988327E-04	0.765652E-04	0.589142E-04	0.450531E-04	0.342586E-04	0.375494E-03	0.411007E-03
55	0.155045E-03	0.122303E-03	0.957599E-04	0.744715E-04	0.575592E-04	0.442366E-04	0.392202E-03	0.429868E-03
56	0.189334E-03	0.150923E-03	0.119414E-03	0.938461E-04	0.732990E-04	0.569279E-04	0.409690E-03	0.449622E-03
57	0.229909E-03	0.185140E-03	0.147986E-03	0.117492E-03	0.927080E-04	0.727401E-04	0.427717E-03	0.469998E-03
58	0.277873E-03	0.225993E-03	0.182424E-03	0.146294E-03	0.116586E-03	0.923918E-04	0.446371E-03	0.491096E-03
59	0.333823E-03	0.274113E-03	0.223424E-03	0.188887E-03	0.145551E-03	0.116459E-03	0.465516E-03	0.512762E-03
60	0.400207E-03	0.331749E-03	0.272979E-03	0.223116E-03	0.181245E-03	0.146405E-03	0.485583E-03	0.535484E-03
61	0.476714E-03	0.398788E-03	0.331154E-03	0.273152E-03	0.223933E-03	0.182553E-03	0.506101E-03	0.558728E-03
62	0.566389E-03	0.478075E-03	0.400579E-03	0.333406E-03	0.275805E-03	0.226879E-03	0.527529E-03	0.583016E-03
63	0.669384E-03	0.569936E-03	0.481722E-03	0.404445E-03	0.337512E-03	0.280076E-03	0.549545E-03	0.607982E-03
64	0.788433E-03	0.677020E-03	0.577122E-03	0.448702E-03	0.411315E-03	0.344252E-03	0.572404E-03	0.633916E-03
65	0.924881E-03	0.800771E-03	0.688291E-03	0.587698E-03	0.498766E-03	0.420937E-03	0.596027E-03	0.660729E-03
66	0.125727E-02	0.110592E-02	0.965787E-03	0.837873E-03	0.722524E-03	0.619605E-03	0.645592E-03	0.717020E-03
67	0.145796E-02	0.129223E-02	0.113714E-02	0.994112E-03	0.863857E-03	0.746526E-03	0.671663E-03	0.746645E-03
68	0.168440E-02	0.150400E-02	0.133334E-02	0.117434E-02	0.102812E-02	0.895145E-03	0.698586E-03	0.777249E-03

NU=	0.126543E-00	0.134259E-00	0.141975E-00	0.149691E-00	0.157407E-00	0.165123E-00	0.172839E-00	0.180556E-00
	BNU	BNU	BNU	BNU	BNU	BNU	BNU	BNU
1	0.757969E-04	0.759113E-04	0.754057E-04	0.743490E-04	0.728121E-04	0.708656E-04	0.685783E-04	0.660156E-04
2	0.757971E-04	0.759115E-04	0.754060E-04	0.743493E-04	0.728124E-04	0.708659E-04	0.685785E-04	0.660159E-04
3	0.758124E-04	0.759277E-04	0.754228E-04	0.743666E-04	0.728301E-04	0.708839E-04	0.685967E-04	0.660341E-04
4	0.767130E-04	0.768745E-04	0.764087E-04	0.753841E-04	0.738715E-04	0.719416E-04	0.696636E-04	0.671032E-04
5	0.771456E-04	0.773295E-04	0.768826E-04	0.758734E-04	0.743725E-04	0.724508E-04	0.701773E-04	0.676182E-04
6	0.777704E-04	0.779869E-04	0.775676E-04	0.765807E-04	0.750970E-04	0.731872E-04	0.709207E-04	0.683637E-04
7	0.786640E-04	0.789275E-04	0.785480E-04	0.775936E-04	0.761349E-04	0.742428E-04	0.719867E-04	0.694332E-04
8	0.799777E-04	0.802583E-04	0.799361E-04	0.792858E-04	0.776062E-04	0.757401E-04	0.734997E-04	0.709522E-04
9	0.816912E-04	0.821171E-04	0.818763E-04	0.810360E-04	0.796664E-04	0.778384E-04	0.756221E-04	0.730849E-04
10	0.828091E-04	0.832962E-04	0.831081E-04	0.831151E-04	0.809763E-04	0.791737E-04	0.769738E-04	0.744444E-04
11	0.841146E-04	0.846740E-04	0.845483E-04	0.838037E-04	0.825099E-04	0.807381E-04	0.785585E-04	0.760394E-04
12	0.856329E-04	0.862775E-04	0.862256E-04	0.855428E-04	0.842987E-04	0.825642E-04	0.804098E-04	0.779042E-04
13	0.873911E-04	0.881359E-04	0.881711E-04	0.875617E-04	0.863770E-04	0.846877E-04	0.825645E-04	0.800766E-04
14	0.894188E-04	0.902809E-04	0.904187E-04	0.898963E-04	0.887825E-04	0.871480E-04	0.850636E-04	0.825988E-04
15	0.917472E-04	0.927465E-04	0.930049E-04	0.925855E-04	0.915564E-04	0.899881E-04	0.879517E-04	0.855170E-04
16	0.944108E-04	0.955701E-04	0.959698E-04	0.956720E-04	0.947440E-04	0.932560E-04	0.912790E-04	0.888832E-04
17	0.974468E-04	0.987922E-04	0.993575E-04	0.992031E-04	0.983956E-04	0.970044E-04	0.951008E-04	0.927553E-04
18	0.100896E-03	0.102458E-03	0.103217E-03	0.103231E-03	0.102567E-03	0.101293E-03	0.994802E-04	0.971991E-04
19	0.104805E-03	0.106618E-03	0.107603E-03	0.107817E-03	0.107323E-03	0.106190E-03	0.104489E-03	0.102290E-03
20	0.106947E-03	0.108904E-03	0.110011E-03	0.110337E-03	0.109941E-03	0.108889E-03	0.107253E-03	0.105103E-03
21	0.109223E-03	0.111327E-03	0.112575E-03	0.113023E-03	0.112732E-03	0.111770E-03	0.111020E-03	0.108111E-03
22	0.111641E-03	0.113907E-03	0.115303E-03	0.115883E-03	0.115708E-03	0.114843E-03	0.113359E-03	0.111327E-03
23	0.114209E-03	0.116650E-03	0.118206E-03	0.118929E-03	0.118879E-03	0.118122E-03	0.116727E-03	0.114765E-03
24	0.116937E-03	0.119565E-03	0.121294E-03	0.121217E-03	0.122260E-03	0.121621E-03	0.120324E-03	0.118439E-03
25	0.119833E-03	0.122663E-03	0.124578E-03	0.125625E-03	0.125862E-03	0.125353E-03	0.124164E-03	0.122368E-03
26	0.122907E-03	0.125955E-03	0.128071E-03	0.129302E-03	0.129702E-03	0.129334E-03	0.128266E-03	0.126568E-03
27	0.126171E-03	0.129454E-03	0.131787E-03	0.13216E-03	0.133794E-03	0.133582E-03	0.132648E-03	0.131060E-03
28	0.129637E-03	0.133172E-03	0.135740E-03	0.137385E-03	0.138197E-03	0.138116E-03	0.137329E-03	0.135865E-03
29	0.133317E-03	0.137124E-03	0.139947E-03	0.141825E-03	0.142809E-03	0.142956E-03	0.142333E-03	0.141006E-03
30	0.137226E-03	0.141326E-03	0.144423E-03	0.146555E-03	0.147770E-03	0.148125E-03	0.147682E-03	0.146509E-03
31	0.141378E-03	0.145794E-03	0.149189E-03	0.151597E-03	0.153064E-03	0.153645E-03	0.153402E-03	0.152401E-03
32	0.145791E-03	0.150547E-03	0.154264E-03	0.156972E-03	0.158715E-03	0.159545E-03	0.159522E-03	0.158713E-03
33	0.150482E-03	0.155650E-03	0.159670E-03	0.162704E-03	0.164748E-03	0.165852E-03	0.166074E-03	0.165479E-03
34	0.155471E-03	0.160990E-03	0.165432E-03	0.168821E-03	0.171194E-03	0.172598E-03	0.173091E-03	0.172734E-03
35	0.160779E-03	0.166727E-03	0.171578E-03	0.175352E-03	0.178084E-03	0.179819E-03	0.180611E-03	0.180520E-03
36	0.166433E-03	0.172843E-03	0.178137E-03	0.182332E-03	0.185457E-03	0.187555E-03	0.188678E-03	0.188885E-03
37	0.172458E-03	0.179368E-03	0.185144E-03	0.194979E-03	0.193352E-03	0.195850E-03	0.197340E-03	0.197877E-03
38	0.178884E-03	0.186335E-03	0.192633E-03	0.197784E-03	0.201811E-03	0.204750E-03	0.206645E-03	0.207552E-03
39	0.185741E-03	0.193779E-03	0.200644E-03	0.206340E-03	0.210884E-03	0.214307E-03	0.216652E-03	0.217970E-03
40	0.193071E-03	0.201743E-03	0.209227E-03	0.215517E-03	0.220628E-03	0.224586E-03	0.227429E-03	0.229207E-03
41	0.200908E-03	0.210270E-03	0.218426E-03	0.225367E-03	0.231099E-03	0.235647E-03	0.239043E-03	0.241333E-03
42	0.209299E-03	0.219410E-03	0.228299E-03	0.242595E-03	0.242367E-03	0.247565E-03	0.251574E-03	0.254436E-03
43	0.218282E-03	0.229206E-03	0.238984E-03	0.247323E-03	0.254489E-03	0.260404E-03	0.265094E-03	0.268594E-03
44	0.227916E-03	0.239725E-03	0.250284E-03	0.259564E-03	0.267556E-03	0.274264E-03	0.279708E-03	0.283920E-03
45	0.238222E-03	0.250991E-03	0.262499E-03	0.272710E-03	0.281606E-03	0.289188E-03	0.295467E-03	0.300472E-03
46	0.261123E-03	0.276069E-03	0.289739E-03	0.302082E-03	0.313065E-03	0.322672E-03	0.330904E-03	0.337776E-03
47	0.287403E-03	0.304915E-03	0.321150E-03	0.336039E-03	0.349531E-03	0.361595E-03	0.372215E-03	0.381391E-03
48	0.317058E-03	0.337357E-03	0.356761E-03	0.374633E-03	0.391085E-03	0.406067E-03	0.419549E-03	0.431512E-03
49	0.350048E-03	0.373912E-03	0.396553E-03	0.417861E-03	0.437745E-03	0.456136E-03	0.472982E-03	0.488248E-03
50	0.367761E-03	0.393472E-03	0.417987E-03	0.441185E-03	0.462964E-03	0.483246E-03	0.501969E-03	0.519089E-03
51	0.386186E-03	0.413837E-03	0.440326E-03	0.465520E-03	0.489307E-03	0.515198E-03	0.532320E-03	0.551421E-03
52	0.405363E-03	0.435053E-03	0.463621E-03	0.490922E-03	0.516835E-03	0.541258E-03	0.564110E-03	0.585325E-03
53	0.425247E-03	0.457071E-03	0.487819E-03	0.517335E-03	0.545488E-03	0.572163E-03	0.597269E-03	0.620732E-03
54	0.445901E-03	0.479961E-03	0.512997E-03	0.545484E-03	0.573537E-03	0.604414E-03	0.631910E-03	0.657761E-03
55	0.466994E-03	0.503356E-03	0.538753E-03	0.573009E-03	0.605969E-03	0.637497E-03	0.667481E-03	0.695824E-03
56	0.489102E-03	0.527896E-03	0.565792E-03	0.602601E-03	0.638158E-03	0.672318E-03	0.704956E-03	0.735964E-03
57	0.511922E-03	0.553245E-03	0.593742E-03	0.639216E-03	0.671490E-03	0.708406E-03	0.743829E-03	0.777642E-03
58	0.535566E-03	0.579527E-03	0.622743E-03	0.665006E-03	0.706127E-03	0.745939E-03	0.784295E-03	0.821066E-03
59	0.559863E-03	0.606551E-03	0.652584E-03	0.697740E-03	0.741821E-03	0.784648E-03	0.826062E-03	0.865925E-03
60	0.585357E-03	0.634927E-03	0.683937E-03	0.732157E-03	0.779377E-03	0.825406E-03	0.870076E-03	0.913236E-03
61	0.611453E-03	0.663988E-03	0.716068E-03	0.774522E-03	0.817917E-03	0.867263E-03	0.915310E-03	0.961897E-03
62	0.638735E-03	0.694388E-03	0.749699E-03	0.804416E-03	0.858307E-03	0.911160E-03	0.962783E-03	0.101300E-02
63	0.666793E-03	0.725669E-03	0.784325E-03	0.842497E-03	0.899943E-03	0.956439E-03	0.101178E-02	0.106579E-02
64	0.695952E-03	0.758194E-03	0.820347E-03	0.892136E-03	0.943308E-03	0.1003636E-02	0.106289E-02	0.112088E-02
65	0.726114E-03	0.791854E-03	0.857644E-03	0.923201E-03	0.988259E-03	0.105257E-02	0.111592E-02	0.117809E-02
66	0.789476E-03	0.862614E-03	0.936109E-03	0.100966E-02	0.108297E-02	0.115578E-02	0.122785E-02	0.129895E-02
67	0.822842E-03	0.898999E-03	0.977482E-03	0.105527E-02	0.113298E-02	0.121033E-02	0.128705E-02	0.136292E-02
68	0.857324E-03	0.938446E-03	0.102027E-02	0.110248E-02	0.118475E-02	0.126681E-02	0.134839E-02	0.142924E-02

NU=	0.188272E-00	0.195988E-00	0.203704E-00	0.211420E-00	0.219136E-00	0.226852E-00	0.234568E-00	0.242284E-00
	BNU							
1	0.632390E-04	0.603048E-04	0.572639E-04	0.541621E-04	0.510393E-04	0.479301E-04	0.448639E-04	0.418654E-04
2	0.632393E-04	0.603050E-04	0.572642E-04	0.541624E-04	0.510396E-04	0.479303E-04	0.448642E-04	0.418656E-04
3	0.632574E-04	0.603230E-04	0.572819E-04	0.541797E-04	0.510564E-04	0.479467E-04	0.448800E-04	0.418809E-04
4	0.643221E-04	0.613773E-04	0.583204E-04	0.551975E-04	0.520492E-04	0.489108E-04	0.458123E-04	0.427789E-04
5	0.648353E-04	0.618857E-04	0.588214E-04	0.556887E-04	0.525286E-04	0.493766E-04	0.462629E-04	0.432131E-04
6	0.655783E-04	0.626221E-04	0.595473E-04	0.564007E-04	0.532236E-04	0.500521E-04	0.469167E-04	0.438434E-04
7	0.666448E-04	0.636796E-04	0.605903E-04	0.574224E-04	0.542233E-04	0.510242E-04	0.478580E-04	0.447513E-04
8	0.681606E-04	0.651836E-04	0.620747E-04	0.588194E-04	0.556648E-04	0.524107E-04	0.492016E-04	0.460482E-04
9	0.702908E-04	0.672993E-04	0.641647E-04	0.609365E-04	0.576583E-04	0.543688E-04	0.511010E-04	0.478834E-04
10	0.716499E-04	0.686503E-04	0.655006E-04	0.622509E-04	0.589465E-04	0.556237E-04	0.523195E-04	0.490618E-04
11	0.732456E-04	0.702376E-04	0.670713E-04	0.637974E-04	0.604612E-04	0.571026E-04	0.537556E-04	0.504527E-04
12	0.751126E-04	0.720965E-04	0.689123E-04	0.656116E-04	0.622407E-04	0.588405E-04	0.554467E-04	0.520901E-04
13	0.772898E-04	0.742661E-04	0.710631E-04	0.677333E-04	0.643239E-04	0.608770E-04	0.574293E-04	0.540126E-04
14	0.798201E-04	0.767904E-04	0.735683E-04	0.702072E-04	0.667556E-04	0.632568E-04	0.597487E-04	0.562644E-04
15	0.827512E-04	0.797181E-04	0.764772E-04	0.740834E-04	0.695863E-04	0.660306E-04	0.624556E-04	0.588958E-04
16	0.861366E-04	0.831040E-04	0.798461E-04	0.764189E-04	0.728737E-04	0.692564E-04	0.656080E-04	0.619645E-04
17	0.900365E-04	0.870103E-04	0.837384E-04	0.802785E-04	0.766833E-04	0.730004E-04	0.692727E-04	0.655376E-04
18	0.945193E-04	0.915075E-04	0.882269E-04	0.847366E-04	0.810911E-04	0.773397E-04	0.735271E-04	0.696929E-04
19	0.996636E-04	0.966774E-04	0.933960E-04	0.898800E-04	0.861856E-04	0.823643E-04	0.784627E-04	0.745225E-04
20	0.102510E-03	0.995422E-04	0.962643E-04	0.977380E-04	0.890206E-04	0.851645E-04	0.812173E-04	0.772220E-04
21	0.105557E-03	0.102611E-03	0.993401E-04	0.958060E-04	0.920669E-04	0.881765E-04	0.841834E-04	0.801317E-04
22	0.108817E-03	0.105899E-03	0.102638E-03	0.990991E-04	0.953402E-04	0.914163E-04	0.873774E-04	0.832685E-04
23	0.112306E-03	0.109420E-03	0.106175E-03	0.102634E-03	0.988580E-04	0.949020E-04	0.908174E-04	0.866507E-04
24	0.116039E-03	0.113193E-03	0.109696E-03	0.106430E-03	0.102639E-03	0.986530E-04	0.945237E-04	0.902990E-04
25	0.120035E-03	0.117235E-03	0.114036E-03	0.110506E-03	0.106704E-03	0.102690E-03	0.985175E-04	0.942350E-04
26	0.124312E-03	0.121566E-03	0.118401E-03	0.114884E-03	0.111076E-03	0.107037E-03	0.102823E-03	0.984835E-04
27	0.128890E-03	0.126209E-03	0.123085E-03	0.119587E-03	0.115778E-03	0.111719E-03	0.107666E-03	0.103071E-03
28	0.133794E-03	0.131187E-03	0.128114E-03	0.124643E-03	0.120840E-03	0.116765E-03	0.112476E-03	0.108028E-03
29	0.139047E-03	0.136526E-03	0.133514E-03	0.130080E-03	0.126289E-03	0.122204E-03	0.117885E-03	0.113386E-03
30	0.144676E-03	0.142255E-03	0.139316E-03	0.135929E-03	0.132159E-03	0.128072E-03	0.123727E-03	0.119181E-03
31	0.150712E-03	0.148405E-03	0.145553E-03	0.142224E-03	0.138487E-03	0.134405E-03	0.130042E-03	0.125456E-03
32	0.157186E-03	0.155012E-03	0.152261E-03	0.149004E-03	0.145311E-03	0.141245E-03	0.136872E-03	0.132249E-03
33	0.164134E-03	0.162111E-03	0.159480E-03	0.156311E-03	0.152675E-03	0.148638E-03	0.144264E-03	0.139614E-03
34	0.171596E-03	0.169745E-03	0.167253E-03	0.164190E-03	0.160628E-03	0.156632E-03	0.152270E-03	0.147603E-03
35	0.179614E-03	0.177960E-03	0.175630E-03	0.172694E-03	0.169223E-03	0.165286E-03	0.160949E-03	0.156276E-03
36	0.188239E-03	0.186810E-03	0.184667E-03	0.181881E-03	0.178524E-03	0.174664E-03	0.170370E-03	0.165706E-03
37	0.197525E-03	0.196351E-03	0.194425E-03	0.191816E-03	0.188596E-03	0.184836E-03	0.180604E-03	0.175966E-03
38	0.207531E-03	0.206642E-03	0.204969E-03	0.202568E-03	0.199515E-03	0.195880E-03	0.191733E-03	0.187142E-03
39	0.218320E-03	0.217766E-03	0.216374E-03	0.214216E-03	0.211361E-03	0.207882E-03	0.203847E-03	0.199327E-03
40	0.229974E-03	0.229794E-03	0.228731E-03	0.227655E-03	0.224237E-03	0.220947E-03	0.217057E-03	0.212636E-03
41	0.242569E-03	0.242812E-03	0.242126E-03	0.240578E-03	0.238239E-03	0.235180E-03	0.231471E-03	0.227183E-03
42	0.256200E-03	0.256923E-03	0.256668E-03	0.255501E-03	0.253490E-03	0.250707E-03	0.247222E-03	0.243107E-03
43	0.270795E-03	0.272217E-03	0.272454E-03	0.271725E-03	0.270099E-03	0.267644E-03	0.264436E-03	0.260540E-03
44	0.286942E-03	0.288824E-03	0.289623E-03	0.289401E-03	0.288224E-03	0.286162E-03	0.283285E-03	0.279663E-03
45	0.304239E-03	0.306814E-03	0.308251E-03	0.307861E-03	0.307956E-03	0.303654E-03	0.303875E-03	0.300591E-03
46	0.343313E-03	0.347552E-03	0.350539E-03	0.352328E-03	0.352975E-03	0.352546E-03	0.351105E-03	0.348724E-03
47	0.389138E-03	0.395479E-03	0.400451E-03	0.404907E-03	0.406468E-03	0.407621E-03	0.407619E-03	0.406525E-03
48	0.441956E-03	0.450891E-03	0.458341E-03	0.464337E-03	0.468922E-03	0.472142E-03	0.474053E-03	0.474715E-03
49	0.501918E-03	0.513984E-03	0.524456E-03	0.533352E-03	0.540701E-03	0.545641E-03	0.550917E-03	0.553880E-03
50	0.534578E-03	0.548422E-03	0.560621E-03	0.571187E-03	0.580142E-03	0.587516E-03	0.593350E-03	0.597690E-03
51	0.568861E-03	0.584620E-03	0.598688E-03	0.610686E-03	0.621775E-03	0.630834E-03	0.638278E-03	0.644148E-03
52	0.604858E-03	0.622676E-03	0.638761E-03	0.653108E-03	0.665724E-03	0.676627E-03	0.685843E-03	0.693407E-03
53	0.644249E-03	0.662514E-03	0.680764E-03	0.697231E-03	0.711913E-03	0.724820E-03	0.735971E-03	0.745359E-03
54	0.681899E-03	0.704273E-03	0.724846E-03	0.743595E-03	0.760510E-03	0.775593E-03	0.788854E-03	0.800317E-03
55	0.722448E-03	0.747293E-03	0.770311E-03	0.791471E-03	0.810752E-03	0.828150E-03	0.843666E-03	0.857315E-03
56	0.765255E-03	0.792756E-03	0.818411E-03	0.842178E-03	0.864028E-03	0.883947E-03	0.901928E-03	0.917978E-03
57	0.809744E-03	0.840055E-03	0.868506E-03	0.895045E-03	0.919636E-03	0.942253E-03	0.962881E-03	0.981520E-03
58	0.856142E-03	0.889429E-03	0.920851E-03	0.950346E-03	0.977865E-03	0.100337E-02	0.102685E-02	0.104828E-02
59	0.904115E-03	0.940528E-03	0.975077E-03	0.107696E-02	0.103830E-02	0.106688E-02	0.109338E-02	0.111780E-02
60	0.954754E-03	0.994514E-03	0.103242E-02	0.116838E-02	0.110234E-02	0.113423E-02	0.116402E-02	0.119167E-02
61	0.100688E-02	0.105013E-02	0.109154E-02	0.113102E-02	0.116848E-02	0.120387E-02	0.123713E-02	0.126821E-02
62	0.106167E-02	0.110863E-02	0.115379E-02	0.119702E-02	0.123824E-02	0.127738E-02	0.131437E-02	0.134916E-02
63	0.111830E-02	0.116916E-02	0.121823E-02	0.126541E-02	0.131058E-02	0.135367E-02	0.139461E-02	0.143332E-02
64	0.117744E-02	0.123241E-02	0.128563E-02	0.133698E-02	0.138636E-02	0.143366E-02	0.147880E-02	0.152171E-02
65	0.123890E-02	0.129818E-02	0.135576E-02	0.141152E-02	0.146533E-02	0.151708E-02	0.156668E-02	0.161405E-02
66	0.136886E-02	0.143739E-02	0.150436E-02	0.156962E-02	0.163301E-02	0.169441E-02	0.175370E-02	0.181077E-02
67	0.143770E-02	0.151120E-02	0.158323E-02	0.165360E-02	0.172218E-02	0.178880E-02	0.185336E-02	0.191572E-02
68	0.150912E-02	0.158781E-02	0.166513E-02	0.174088E-02	0.181489E-02	0.188702E-02	0.195712E-02	0.202506E-02

NU#	0.250000E-00	0.625000E-01	0.706019E-01	0.77037E-01	0.868056E-01	0.949074E-01	0.103009E-00	0.111111E-00
	BNU	BNU	BNU	BNU	BNU	BNU	BNU	BNU
1	0.389545E-04	0.455469E-04	0.522382E-04	0.592142E-04	0.633674E-04	0.676361E-04	0.709972E-04	0.734592E-04
2	0.389547E-04	0.455470E-04	0.522384E-04	0.592144E-04	0.633675E-04	0.676362E-04	0.709974E-04	0.734594E-04
3	0.389694E-04	0.455527E-04	0.522454E-04	0.592228E-04	0.633772E-04	0.676473E-04	0.710097E-04	0.734729E-04
4	0.398311E-04	0.458903E-04	0.526594E-04	0.597150E-04	0.639476E-04	0.682940E-04	0.717294E-04	0.742608E-04
5	0.402480E-04	0.460521E-04	0.528579E-04	0.599510E-04	0.642212E-04	0.686043E-04	0.720748E-04	0.746391E-04
6	0.408533E-04	0.462853E-04	0.531440E-04	0.592913E-04	0.646158E-04	0.690520E-04	0.725733E-04	0.751851E-04
7	0.417258E-04	0.466180E-04	0.535522E-04	0.597771E-04	0.651791E-04	0.696913E-04	0.732854E-04	0.759654E-04
8	0.429729E-04	0.470866E-04	0.541275E-04	0.614136E-04	0.659737E-04	0.705934E-04	0.742907E-04	0.770677E-04
9	0.447395E-04	0.477373E-04	0.549267E-04	0.614136E-04	0.670786E-04	0.718488E-04	0.756907E-04	0.786037E-04
10	0.458749E-04	0.481478E-04	0.554311E-04	0.670147E-04	0.677768E-04	0.726424E-04	0.765764E-04	0.795761E-04
11	0.472161E-04	0.486253E-04	0.560181E-04	0.677143E-04	0.685898E-04	0.735672E-04	0.776088E-04	0.807103E-04
12	0.487965E-04	0.491781E-04	0.566979E-04	0.673525E-04	0.695326E-04	0.746400E-04	0.788073E-04	0.820277E-04
13	0.506539E-04	0.498150E-04	0.574816E-04	0.644602E-04	0.706205E-04	0.758788E-04	0.801922E-04	0.835510E-04
14	0.528320E-04	0.505454E-04	0.583807E-04	0.655337E-04	0.718701E-04	0.773029E-04	0.817853E-04	0.853049E-04
15	0.553805E-04	0.513787E-04	0.594072E-04	0.667602E-04	0.732990E-04	0.789323E-04	0.836098E-04	0.873153E-04
16	0.583569E-04	0.523253E-04	0.605740E-04	0.681152E-04	0.749255E-04	0.807888E-04	0.856906E-04	0.896103E-04
17	0.618279E-04	0.533959E-04	0.618946E-04	0.697355E-04	0.767696E-04	0.828959E-04	0.880543E-04	0.922204E-04
18	0.658716E-04	0.546402E-04	0.633836E-04	0.715188E-04	0.852784E-04	0.907303E-04	0.951786E-04	
19	0.705804E-04	0.559564E-04	0.650571E-04	0.715251E-04	0.811988E-04	0.879646E-04	0.937508E-04	0.985222E-04
20	0.732163E-04	0.566931E-04	0.659680E-04	0.746179E-04	0.824777E-04	0.894303E-04	0.954007E-04	0.100350E-03
21	0.760605E-04	0.574721E-04	0.669316E-04	0.757747E-04	0.838323E-04	0.909836E-04	0.971502E-04	0.102290E-03
22	0.791300E-04	0.582954E-04	0.679506E-04	0.769984E-04	0.852661E-04	0.926289E-04	0.990047E-04	0.104348E-03
23	0.824435E-04	0.591651E-04	0.690275E-04	0.782926E-04	0.868734E-04	0.943712E-04	0.100970E-03	0.106530E-03
24	0.860218E-04	0.600836E-04	0.701654E-04	0.796609E-04	0.883886E-04	0.962156E-04	0.103052E-03	0.108844E-03
25	0.898871E-04	0.610533E-04	0.713674E-04	0.811070E-04	0.900862E-04	0.981675E-04	0.105257E-03	0.111297E-03
26	0.940644E-04	0.620768E-04	0.726368E-04	0.876352E-04	0.918813E-04	0.100233E-03	0.107592E-03	0.113896E-03
27	0.985810E-04	0.631569E-04	0.739772E-04	0.842498E-04	0.937793E-04	0.102419E-03	0.110064E-03	0.116651E-03
28	0.103467E-03	0.642968E-04	0.753925E-04	0.859559E-04	0.957861E-04	0.104731E-03	0.112683E-03	0.119571E-03
29	0.108757E-03	0.654598E-04	0.768871E-04	0.877584E-04	0.979080E-04	0.107179E-03	0.115456E-03	0.122666E-03
30	0.114486E-03	0.667693E-04	0.784652E-04	0.896632E-04	0.100152E-03	0.109768E-03	0.118393E-03	0.125947E-03
31	0.120696E-03	0.681092E-04	0.801320E-04	0.916762E-04	0.102525E-03	0.112509E-03	0.121505E-03	0.129426E-03
32	0.127432E-03	0.695523E-04	0.818926E-04	0.918041E-04	0.105035E-03	0.115412E-03	0.124802E-03	0.133116E-03
33	0.134744E-03	0.710175E-04	0.837529E-04	0.960540E-04	0.107692E-03	0.118485E-03	0.128297E-03	0.137031E-03
34	0.142689E-03	0.725953E-04	0.857192E-04	0.984338E-04	0.110503E-03	0.121741E-03	0.132003E-03	0.141186E-03
35	0.151328E-03	0.742626E-04	0.877984E-04	0.100952E-03	0.113481E-03	0.125192E-03	0.135935E-03	0.145599E-03
36	0.160734E-03	0.760261E-04	0.899989E-04	0.107361E-03	0.116637E-03	0.128853E-03	0.140109E-03	0.150289E-03
37	0.170986E-03	0.778921E-04	0.923289E-04	0.1096445E-03	0.119985E-03	0.132739E-03	0.144545E-03	0.155277E-03
38	0.182170E-03	0.798680E-04	0.947977E-04	0.109442E-03	0.123537E-03	0.136867E-03	0.149260E-03	0.160585E-03
39	0.194386E-03	0.819616E-04	0.974154E-04	0.112621E-03	0.127309E-03	0.141253E-03	0.154276E-03	0.166238E-03
40	0.207751E-03	0.841830E-04	0.100195E-03	0.116000E-03	0.131320E-03	0.145923E-03	0.159621E-03	0.172267E-03
41	0.222384E-03	0.865411E-04	0.103147E-03	0.119591E-03	0.135588E-03	0.150895E-03	0.165318E-03	0.178700E-03
42	0.238432E-03	0.890473E-04	0.106287E-03	0.127341E-03	0.140134E-03	0.156197E-03	0.171398E-03	0.185573E-03
43	0.256030E-03	0.917105E-04	0.109626E-03	0.127482E-03	0.144975E-03	0.161848E-03	0.177885E-03	0.192914E-03
44	0.275369E-03	0.945456E-04	0.113183E-03	0.131181E-03	0.150141E-03	0.167883E-03	0.184821E-03	0.200770E-03
45	0.296571E-03	0.975563E-04	0.116962E-03	0.136431E-03	0.155640E-03	0.174313E-03	0.192217E-03	0.209157E-03
46	0.345471E-03	0.104171E-03	0.125275E-03	0.146586E-03	0.167763E-03	0.188508E-03	0.208569E-03	0.227729E-03
47	0.404409E-03	0.111652E-03	0.134690E-03	0.158104E-03	0.181535E-03	0.204663E-03	0.227214E-03	0.248950E-03
48	0.474191E-03	0.119975E-03	0.145176E-03	0.170953E-03	0.196922E-03	0.222745E-03	0.248123E-03	0.272795E-03
49	0.555488E-03	0.129110E-03	0.156701E-03	0.181509E-03	0.213881E-03	0.242706E-03	0.271246E-03	0.299216E-03
50	0.600588E-03	0.133968E-03	0.162835E-03	0.192626E-03	0.222927E-03	0.253366E-03	0.283610E-03	0.313362E-03
51	0.648492E-03	0.138992E-03	0.169182E-03	0.200246E-03	0.232297E-03	0.264416E-03	0.296436E-03	0.328050E-03
52	0.699361E-03	0.144190E-03	0.175753E-03	0.208504E-03	0.242010E-03	0.275879E-03	0.309752E-03	0.343312E-03
53	0.753128E-03	0.149551E-03	0.182532E-03	0.216844E-03	0.252044E-03	0.287727E-03	0.323526E-03	0.359110E-03
54	0.810009E-03	0.155090E-03	0.189540E-03	0.225740E-03	0.262424E-03	0.299997E-03	0.337800E-03	0.375494E-03
55	0.869121E-03	0.160719E-03	0.196666E-03	0.234246E-03	0.272996E-03	0.312493E-03	0.352346E-03	0.392202E-03
56	0.932113E-03	0.166592E-03	0.204103E-03	0.243408E-03	0.284037E-03	0.325555E-03	0.367561E-03	0.409690E-03
57	0.998176E-03	0.172627E-03	0.211748E-03	0.252832E-03	0.295399E-03	0.339003E-03	0.383235E-03	0.427717E-03
58	0.106767E-02	0.178854E-03	0.219639E-03	0.262563E-03	0.307136E-03	0.352903E-03	0.399444E-03	0.446371E-03
59	0.114011E-02	0.185226E-03	0.227718E-03	0.272530E-03	0.319163E-03	0.367154E-03	0.416071E-03	0.465516E-03
60	0.121718E-02	0.191888E-03	0.236166E-03	0.292956E-03	0.331750E-03	0.382074E-03	0.433489E-03	0.485583E-03
61	0.129710E-02	0.198681E-03	0.244785E-03	0.293957E-03	0.344601E-03	0.397315E-03	0.451288E-03	0.506101E-03
62	0.138171E-02	0.205759E-03	0.253768E-03	0.304690E-03	0.358004E-03	0.413217E-03	0.469868E-03	0.527529E-03
63	0.146977E-02	0.213015E-03	0.262978E-03	0.316069E-03	0.371756E-03	0.429540E-03	0.488949E-03	0.549545E-03
64	0.156233E-02	0.220532E-03	0.272523E-03	0.327865E-03	0.386018E-03	0.446473E-03	0.508752E-03	0.572404E-03
65	0.165911E-02	0.228285E-03	0.282370E-03	0.340037E-03	0.400739E-03	0.463959E-03	0.529208E-03	0.596027E-03
66	0.186555E-02	0.244503E-03	0.302976E-03	0.365521E-03	0.431575E-03	0.500604E-03	0.572103E-03	0.645592E-03
67	0.197580E-02	0.253011E-03	0.313790E-03	0.378900E-03	0.447770E-03	0.519859E-03	0.594653E-03	0.671663E-03
68	0.209074E-02	0.261782E-03	0.324941E-03	0.392699E-03	0.464478E-03	0.539730E-03	0.617932E-03	0.698586E-03

NU=	0.400000E-01	0.437500E-01	0.475000E-01	0.512500E-01	0.550000E-01	0.587500E-01	0.625000E-01	0.277778E-01
	BNU	BNU	BNU	BNU	BNU	BNU	BNU	BNU
1	0.247866E-04	0.283165E-04	0.318591E-04	0.353814E-04	0.388538E-04	0.422500E-04	0.455469E-04	0.138405E-04
2	0.247866E-04	0.283165E-04	0.318591E-04	0.353815E-04	0.388539E-04	0.422501E-04	0.455469E-04	0.138405E-04
3	0.247892E-04	0.283166E-04	0.318627E-04	0.353855E-04	0.388585E-04	0.422553E-04	0.455527E-04	0.138418E-04
4	0.249399E-04	0.284977E-04	0.320700E-04	0.356236E-04	0.391286E-04	0.425587E-04	0.458903E-04	0.139167E-04
5	0.250121E-04	0.285831E-04	0.321693E-04	0.357376E-04	0.392581E-04	0.427040E-04	0.460521E-04	0.139526E-04
6	0.251161E-04	0.287061E-04	0.323125E-04	0.359020E-04	0.394446E-04	0.429136E-04	0.462853E-04	0.140044E-04
7	0.252644E-04	0.288814E-04	0.325166E-04	0.361364E-04	0.397106E-04	0.432124E-04	0.466180E-04	0.140781E-04
8	0.254731E-04	0.291282E-04	0.328039E-04	0.364664E-04	0.400853E-04	0.436333E-04	0.470866E-04	0.141819E-04
9	0.257626E-04	0.2947C6E-04	0.332026E-04	0.369244E-04	0.406052E-04	0.442177E-04	0.477373E-04	0.143258E-04
10	0.259450E-04	0.296865E-04	0.334540E-04	0.372132E-04	0.409332E-04	0.445862E-04	0.481478E-04	0.144164E-04
11	0.261571E-04	0.299373E-04	0.337461E-04	0.375489E-04	0.413145E-04	0.450149E-04	0.486253E-04	0.145217E-04
12	0.264023E-04	0.302276E-04	0.340842E-04	0.379374E-04	0.417558E-04	0.455111E-04	0.491781E-04	0.146435E-04
13	0.266846E-04	0.305616E-04	0.344734E-04	0.383848E-04	0.422640E-04	0.460826E-04	0.498150E-04	0.147836E-04
14	0.270079E-04	0.309443E-04	0.349193E-04	0.389747E-04	0.428466E-04	0.467378E-04	0.505453E-04	0.149439E-04
15	0.273764E-04	0.313805E-04	0.354276E-04	0.394819E-04	0.435109E-04	0.474853E-04	0.513787E-04	0.151266E-04
16	0.277942E-04	0.318752E-04	0.360043E-04	0.401453E-04	0.442651E-04	0.483340E-04	0.523253E-04	0.153336E-04
17	0.282661E-04	0.324341E-04	0.366559E-04	0.408949E-04	0.451117E-04	0.492937E-04	0.533958E-04	0.155673E-04
18	0.287967E-04	0.330627E-04	0.373891E-04	0.417386E-04	0.460774E-04	0.503745E-04	0.546020E-04	0.158300E-04
19	0.293915E-04	0.337674E-04	0.382112E-04	0.426851E-04	0.471544E-04	0.515877E-04	0.559564E-04	0.161241E-04
20	0.297145E-04	0.341503E-04	0.386580E-04	0.419195E-04	0.477399E-04	0.522474E-04	0.566931E-04	0.162838E-04
21	0.300557E-04	0.345548E-04	0.391300E-04	0.477431E-04	0.483588E-04	0.529494E-04	0.574721E-04	0.164524E-04
22	0.304160E-04	0.349818E-04	0.396285E-04	0.443173E-04	0.490126E-04	0.536818E-04	0.582954E-04	0.166303E-04
23	0.307961E-04	0.354325E-04	0.401547E-04	0.449235E-04	0.497029E-04	0.544601E-04	0.591651E-04	0.168180E-04
24	0.311971E-04	0.359081E-04	0.407100E-04	0.455633E-04	0.504317E-04	0.552819E-04	0.600836E-04	0.170159E-04
25	0.316199E-04	0.364969E-04	0.412957E-04	0.442283E-04	0.512007E-04	0.561493E-04	0.610533E-04	0.172245E-04
26	0.320657E-04	0.369384E-04	0.419133E-04	0.449503E-04	0.520121E-04	0.570646E-04	0.620768E-04	0.174443E-04
27	0.325356E-04	0.374959E-04	0.425646E-04	0.477011E-04	0.528679E-04	0.580304E-04	0.631569E-04	0.176759E-04
28	0.330308E-04	0.380836E-04	0.432513E-04	0.494930E-04	0.537707E-04	0.590493E-04	0.642968E-04	0.179199E-04
29	0.335528E-04	0.387031E-04	0.439754E-04	0.493281E-04	0.547229E-04	0.601243E-04	0.654998E-04	0.181769E-04
30	0.341030E-04	0.393562E-04	0.447388E-04	0.502088E-04	0.557273E-04	0.612585E-04	0.667693E-04	0.184477E-04
31	0.346829E-04	0.400447E-04	0.455438E-04	0.511376E-04	0.567870E-04	0.624554E-04	0.681092E-04	0.187330E-04
32	0.352943E-04	0.407708E-04	0.463928E-04	0.571175E-04	0.579051E-04	0.637186E-04	0.695238E-04	0.190336E-04
33	0.359390E-04	0.415366E-04	0.472885E-04	0.531514E-04	0.590815E-04	0.650520E-04	0.710175E-04	0.193505E-04
34	0.366190E-04	0.423445E-04	0.482336E-04	0.542427E-04	0.603309E-04	0.664602E-04	0.725953E-04	0.196846E-04
35	0.373367E-04	0.431972E-04	0.492314E-04	0.553953E-04	0.616467E-04	0.679479E-04	0.742626E-04	0.200369E-04
36	0.380947E-04	0.440980E-04	0.502856E-04	0.546128E-04	0.630376E-04	0.695209E-04	0.760260E-04	0.204089E-04
37	0.388956E-04	0.450500E-04	0.514001E-04	0.579005E-04	0.645087E-04	0.711849E-04	0.778921E-04	0.208017E-04
38	0.397424E-04	0.460568E-04	0.525789E-04	0.592628E-04	0.666065E-04	0.729464E-04	0.798680E-04	0.212169E-04
39	0.406384E-04	0.471223E-04	0.538267E-04	0.670752E-04	0.677141E-04	0.748123E-04	0.819616E-04	0.216559E-04
40	0.415878E-04	0.482514E-04	0.551493E-04	0.673234E-04	0.694642E-04	0.767916E-04	0.841830E-04	0.221207E-04
41	0.425940E-04	0.494484E-04	0.565517E-04	0.638563E-04	0.713172E-04	0.788920E-04	0.865411E-04	0.226132E-04
42	0.436619E-04	0.507191E-04	0.580408E-04	0.655578E-04	0.732875E-04	0.811238E-04	0.890473E-04	0.231356E-04
43	0.447950E-04	0.520675E-04	0.595621E-04	0.674076E-04	0.753797E-04	0.834946E-04	0.917104E-04	0.236896E-04
44	0.459995E-04	0.535013E-04	0.613022E-04	0.693529E-04	0.776062E-04	0.860177E-04	0.945455E-04	0.247282E-04
45	0.472767E-04	0.550219E-04	0.630854E-04	0.714170E-04	0.799691E-04	0.886964E-04	0.975562E-04	0.249020E-04
46	0.500766E-04	0.585355E-04	0.669970E-04	0.759466E-04	0.851563E-04	0.945793E-04	0.104171E-03	0.262684E-04
47	0.532341E-04	0.621118E-04	0.714111E-04	0.810611E-04	0.910163E-04	0.101229E-03	0.111652E-03	0.278076E-04
48	0.567336E-04	0.662931E-04	0.763130E-04	0.857421E-04	0.975285E-04	0.108622E-03	0.119975E-03	0.295135E-04
49	0.605713E-04	0.708649E-04	0.816825E-04	0.979684E-04	0.104669E-03	0.116733E-03	0.129110E-03	0.313790E-04
50	0.626070E-04	0.732926E-04	0.845346E-04	0.962765E-04	0.108464E-03	0.121045E-03	0.133968E-03	0.323688E-04
51	0.647092E-04	0.758C01E-04	0.874810E-04	0.996947E-04	0.112386E-03	0.125502E-03	0.138992E-03	0.333904E-04
52	0.668823E-04	0.783925E-04	0.905276E-04	0.103230E-03	0.116443E-03	0.130114E-03	0.144190E-03	0.344641E-04
53	0.691207E-04	0.810633E-04	0.936669E-04	0.116873E-03	0.120625E-03	0.134868E-03	0.149551E-03	0.355331E-04
54	0.714314E-04	0.838207E-04	0.969084E-04	0.110635E-03	0.124945E-03	0.139781E-03	0.155090E-03	0.366548E-04
55	0.737774E-04	0.866206E-04	0.100200E-03	0.114457E-03	0.129333E-03	0.144772E-03	0.160719E-03	0.377932E-04
56	0.762225E-04	0.895392E-04	0.103632E-03	0.118442E-03	0.133909E-03	0.149978E-03	0.166592E-03	0.389795E-04
57	0.787332E-04	0.925363E-04	0.107157E-03	0.1272535E-03	0.138611E-03	0.155326E-03	0.172627E-03	0.401970E-04
58	0.813214E-04	0.956262E-04	0.110792E-03	0.137655E-03	0.143459E-03	0.160844E-03	0.178853E-03	0.414517E-04
59	0.839682E-04	0.987866E-04	0.114509E-03	0.131074E-03	0.148421E-03	0.166490E-03	0.185226E-03	0.427346E-04
60	0.867330E-04	0.102088E-03	0.118393E-03	0.135586E-03	0.153605E-03	0.172392E-03	0.191888E-03	0.440743E-04
61	0.895506E-04	0.105453E-03	0.122353E-03	0.140186E-03	0.158892E-03	0.178409E-03	0.198681E-03	0.454392E-04
62	0.924844E-04	0.108957E-03	0.126476E-03	0.144977E-03	0.164398E-03	0.184678E-03	0.205759E-03	0.468601E-04
63	0.954897E-04	0.112547E-03	0.130700E-03	0.149886E-03	0.170040E-03	0.191103E-03	0.213015E-03	0.483152E-04
64	0.986014E-04	0.116264E-03	0.135075E-03	0.154970E-03	0.178588E-03	0.197759E-03	0.220532E-03	0.498216E-04
65	0.101809E-03	0.120096E-03	0.139585E-03	0.150212E-03	0.181912E-03	0.204623E-03	0.228284E-03	0.513740E-04
66	0.108513E-03	0.128106E-03	0.149015E-03	0.171171E-03	0.194516E-03	0.218980E-03	0.244503E-03	0.546180E-04
67	0.112028E-03	0.132306E-03	0.153959E-03	0.176921E-03	0.201126E-03	0.226510E-03	0.253011E-03	0.563181E-04
68	0.115650E-03	0.136634E-03	0.159054E-03	0.182845E-03	0.207939E-03	0.234272E-03	0.261782E-03	0.580697E-04

NU=	0.308333E-01	0.338889E-01	0.369444E-01	0.400000E-01	0.204082E-01	0.240930E-01	0.277778E-01	0.156250E-01
	BNU	BNU	BNU	BNU	BNU	BNU	BNU	BNU
1	0.164478E-04	0.191577E-04	0.219450E-04	0.247866E-04	0.813903E-05	0.108706E-04	0.138405E-04	0.503823E-05
2	0.164478E-04	0.191577E-04	0.219450E-04	0.247866E-04	0.813904E-05	0.108706E-04	0.138405E-04	0.503824E-05
3	0.164494E-04	0.191596E-04	0.219473E-04	0.247892E-04	0.813975E-05	0.108715E-04	0.138418E-04	0.503865E-05
4	0.165412E-04	0.192696E-04	0.220769E-04	0.249399E-04	0.818077E-05	0.109284E-04	0.139167E-04	0.506285E-05
5	0.165851E-04	0.193223E-04	0.221391E-04	0.250121E-04	0.820041E-05	0.109556E-04	0.139526E-04	0.507444E-05
6	0.166484E-04	0.193982E-04	0.222286E-04	0.251116E-04	0.822871E-05	0.109948E-04	0.140044E-04	0.509114E-05
7	0.167387E-04	0.195064E-04	0.223556E-04	0.252643E-04	0.826904E-05	0.110506E-04	0.140781E-04	0.511493E-05
8	0.168657E-04	0.196588E-04	0.225358E-04	0.254731E-04	0.832579E-05	0.111293E-04	0.141819E-04	0.514841E-05
9	0.170418E-04	0.1987C0E-04	0.227848E-04	0.257626E-04	0.840445E-05	0.112382E-04	0.143257E-04	0.519481E-05
10	0.171528E-04	0.200031E-04	0.229418E-04	0.259450E-04	0.845401E-05	0.113069E-04	0.144164E-04	0.522404E-05
11	0.172817E-04	0.201577E-04	0.231242E-04	0.261571E-04	0.851157E-05	0.113867E-04	0.145217E-04	0.525799E-05
12	0.174308E-04	0.203366E-04	0.233351E-04	0.264023E-04	0.857812E-05	0.114789E-04	0.146435E-04	0.529724E-05
13	0.176023E-04	0.205424E-04	0.235779E-04	0.266846E-04	0.865466E-05	0.115850E-04	0.147835E-04	0.534239E-05
14	0.177987E-04	0.207780E-04	0.238559E-04	0.270079E-04	0.874230E-05	0.117064E-04	0.149439E-04	0.539405E-05
15	0.180224E-04	0.210465E-04	0.241727E-04	0.273763E-04	0.884208E-05	0.118447E-04	0.151266E-04	0.545288E-05
16	0.182760E-04	0.2135C9E-04	0.245319E-04	0.277942E-04	0.895516E-05	0.120015E-04	0.153336E-04	0.551955E-05
17	0.185623E-04	0.216945E-04	0.249374E-04	0.292660E-04	0.908274E-05	0.121783E-04	0.155673E-04	0.559475E-05
18	0.188841E-04	0.220808E-04	0.253934E-04	0.297967E-04	0.922610E-05	0.123771E-04	0.158300E-04	0.567924E-05
19	0.192445E-04	0.225137E-04	0.259045E-04	0.293915E-04	0.938661E-05	0.125997E-04	0.161241E-04	0.577383E-05
20	0.194402E-04	0.227487E-04	0.261820E-04	0.297145E-04	0.947372E-05	0.127205E-04	0.162838E-04	0.582516E-05
21	0.196469E-04	0.229969E-04	0.264751E-04	0.300557E-04	0.956569E-05	0.128481E-04	0.164524E-04	0.587934E-05
22	0.198650E-04	0.232588E-04	0.267845E-04	0.304160E-04	0.966273E-05	0.129827E-04	0.166303E-04	0.593651E-05
23	0.200950E-04	0.235352E-04	0.271109E-04	0.307796E-04	0.976506E-05	0.131246E-04	0.168180E-04	0.599679E-05
24	0.203377E-04	0.238267E-04	0.274552E-04	0.31171E-04	0.987295E-05	0.132743E-04	0.170159E-04	0.606034E-05
25	0.205934E-04	0.241339E-04	0.278182E-04	0.316199E-04	0.998665E-05	0.134320E-04	0.172245E-04	0.612730E-05
26	0.208629E-04	0.244578E-04	0.282009E-04	0.320657E-04	0.101064E-04	0.135938E-04	0.174443E-04	0.619785E-05
27	0.211469E-04	0.247991E-04	0.286042E-04	0.329356E-04	0.102326E-04	0.137734E-04	0.176759E-04	0.627215E-05
28	0.214462E-04	0.251587E-04	0.290293E-04	0.330308E-04	0.103655E-04	0.139578E-04	0.179199E-04	0.635014E-05
29	0.217614E-04	0.255377E-04	0.294772E-04	0.335258E-04	0.105055E-04	0.141521E-04	0.181769E-04	0.643283E-05
30	0.220936E-04	0.259370E-04	0.299492E-04	0.341030E-04	0.106530E-04	0.143568E-04	0.184477E-04	0.651963E-05
31	0.224436E-04	0.263578E-04	0.304467E-04	0.346829E-04	0.108083E-04	0.145724E-04	0.187330E-04	0.661106E-05
32	0.228124E-04	0.268013E-04	0.309712E-04	0.352934E-04	0.109719E-04	0.147996E-04	0.190336E-04	0.670737E-05
33	0.232012E-04	0.272689E-04	0.315241E-04	0.359390E-04	0.111444E-04	0.150390E-04	0.193505E-04	0.680885E-05
34	0.236112E-04	0.277619E-04	0.321073E-04	0.361619E-04	0.113261E-04	0.152914E-04	0.196846E-04	0.691580E-05
35	0.240437E-04	0.282821E-04	0.327226E-04	0.373367E-04	0.115178E-04	0.155576E-04	0.200369E-04	0.702857E-05
36	0.245002E-04	0.288314E-04	0.333724E-04	0.380946E-04	0.117201E-04	0.158385E-04	0.204089E-04	0.714757E-05
37	0.249825E-04	0.294116E-04	0.340589E-04	0.384956E-04	0.119337E-04	0.161352E-04	0.208017E-04	0.727322E-05
38	0.254942E-04	0.300249E-04	0.347847E-04	0.397424E-04	0.121593E-04	0.164487E-04	0.212169E-04	0.740595E-05
39	0.260312E-04	0.306736E-04	0.355524E-04	0.416384E-04	0.123979E-04	0.167802E-04	0.216559E-04	0.754627E-05
40	0.266021E-04	0.313607E-04	0.363658E-04	0.415877E-04	0.126505E-04	0.171311E-04	0.2221207E-04	0.769481E-05
41	0.272069E-04	0.320888E-04	0.372278E-04	0.425940E-04	0.129180E-04	0.175029E-04	0.226132E-04	0.785211E-05
42	0.278486E-04	0.328613E-04	0.381425E-04	0.436161E-04	0.132017E-04	0.178972E-04	0.231356E-04	0.801892E-05
43	0.285291E-04	0.336807E-04	0.391128E-04	0.447795E-04	0.135025E-04	0.181353E-04	0.236896E-04	0.819574E-05
44	0.292523E-04	0.345515E-04	0.401442E-04	0.459995E-04	0.138220E-04	0.187594E-04	0.242782E-04	0.838354E-05
45	0.300187E-04	0.354746E-04	0.412376E-04	0.472766E-04	0.141606E-04	0.192300E-04	0.249020E-04	0.858251E-05
46	0.316979E-04	0.374974E-04	0.436342E-04	0.507666E-04	0.149019E-04	0.202608E-04	0.262684E-04	0.901813E-05
47	0.335900E-04	0.397772E-04	0.463359E-04	0.512341E-04	0.157366E-04	0.214216E-04	0.278076E-04	0.950852E-05
48	0.356873E-04	0.423049E-04	0.493323E-04	0.567369E-04	0.166612E-04	0.227078E-04	0.295134E-04	0.100516E-04
49	0.379815E-04	0.450705E-04	0.526115E-04	0.605713E-04	0.176720E-04	0.241142E-04	0.313790E-04	0.106453E-04
50	0.391988E-04	0.465381E-04	0.543521E-04	0.626070E-04	0.182082E-04	0.248601E-04	0.323688E-04	0.109600E-04
51	0.404555E-04	0.480535E-04	0.561493E-04	0.647092E-04	0.187615E-04	0.256301E-04	0.333904E-04	0.112849E-04
52	0.417542E-04	0.496195E-04	0.580069E-04	0.668822E-04	0.193331E-04	0.264256E-04	0.344461E-04	0.116205E-04
53	0.430915E-04	0.512323E-04	0.599202E-04	0.691207E-04	0.199216E-04	0.272474E-04	0.355331E-04	0.119660E-04
54	0.444715E-04	0.528968E-04	0.618950E-04	0.717314E-04	0.205287E-04	0.280898E-04	0.366548E-04	0.123224E-04
55	0.458723E-04	0.545865E-04	0.638999E-04	0.737774E-04	0.211449E-04	0.289475E-04	0.377932E-04	0.126840E-04
56	0.473320E-04	0.563473E-04	0.659893E-04	0.762226E-04	0.217868E-04	0.298411E-04	0.389794E-04	0.130607E-04
57	0.488303E-04	0.581549E-04	0.681344E-04	0.747332E-04	0.224456E-04	0.307582E-04	0.401970E-04	0.134473E-04
58	0.503745E-04	0.600179E-04	0.703455E-04	0.813213E-04	0.231244E-04	0.317033E-04	0.414517E-04	0.138457E-04
59	0.519534E-04	0.619230E-04	0.726066E-04	0.879682E-04	0.238183E-04	0.326695E-04	0.427346E-04	0.142529E-04
60	0.536023E-04	0.639127E-04	0.749683E-04	0.867329E-04	0.245629E-04	0.336784E-04	0.440743E-04	0.146781E-04
61	0.552824E-04	0.659401E-04	0.773750E-04	0.895908E-04	0.292811E-04	0.347083E-04	0.454392E-04	0.151122E-04
62	0.570314E-04	0.680508E-04	0.798807E-04	0.974843E-04	0.260495E-04	0.357762E-04	0.468600E-04	0.155620E-04
63	0.588228E-04	0.702127E-04	0.824473E-04	0.954897E-04	0.268363E-04	0.368720E-04	0.483152E-04	0.160236E-04
64	0.606773E-04	0.724509E-04	0.851047E-04	0.996014E-04	0.276507E-04	0.380062E-04	0.498216E-04	0.165014E-04
65	0.625884E-04	0.747576E-04	0.878436E-04	0.101809E-03	0.284899E-04	0.391750E-04	0.513740E-04	0.169937E-04
66	0.6465826E-04	0.795788E-04	0.935684E-04	0.108513E-03	0.302435E-04	0.416173E-04	0.546180E-04	0.180223E-04
67	0.6686758E-04	0.821057E-04	0.965690E-04	0.112028E-03	0.311623E-04	0.428972E-04	0.563181E-04	0.185612E-04
68	0.708326E-04	0.847093E-04	0.996610E-04	0.115650E-03	0.321090E-04	0.442158E-04	0.580697E-04	0.191165E-04

NU#	0.180166E-01	0.204082E-01	0.123457E-01	0.139853E-01	0.156250E-01	0.100000E-01	0.111728E-01	0.123457E-01
	BNU	BNU	BNU	BNU	BNU	BNU	BNU	BNU
1	0.651919E-05	0.813903E-05	0.326347E-05	0.411161E-05	0.503823E-05	0.219783E-05	0.270807E-05	0.326347E-05
2	0.651919E-05	0.813904E-05	0.326348E-05	0.411162E-05	0.503824E-05	0.219783E-05	0.270808E-05	0.326348E-05
3	0.651974E-05	0.813974E-05	0.326373E-05	0.411195E-05	0.503865E-05	0.219800E-05	0.270829E-05	0.326373E-05
4	0.655182E-05	0.818076E-05	0.327890E-05	0.413137E-05	0.506285E-05	0.220797E-05	0.272072E-05	0.327890E-05
5	0.656719E-05	0.820041E-05	0.328616E-05	0.414068E-05	0.507444E-05	0.221274E-05	0.272667E-05	0.328616E-05
6	0.658932E-05	0.822871E-05	0.329662E-05	0.415408E-05	0.509114E-05	0.221962E-05	0.273525E-05	0.329662E-05
7	0.662086E-05	0.826904E-05	0.331152E-05	0.417317E-05	0.511493E-05	0.222942E-05	0.274747E-05	0.331152E-05
8	0.666524E-05	0.832579E-05	0.333249E-05	0.420004E-05	0.514841E-05	0.224320E-05	0.276466E-05	0.333249E-05
9	0.672575E-05	0.840445E-05	0.336156E-05	0.423728E-05	0.519481E-05	0.226231E-05	0.278849E-05	0.336156E-05
10	0.676550E-05	0.845450E-05	0.337987E-05	0.426707E-05	0.522404E-05	0.227435E-05	0.280350E-05	0.337987E-05
11	0.681051E-05	0.851157E-05	0.340113E-05	0.428799E-05	0.525799E-05	0.228832E-05	0.282094E-05	0.340113E-05
12	0.686254E-05	0.857812E-05	0.342572E-05	0.431948E-05	0.529724E-05	0.230448E-05	0.284109E-05	0.342571E-05
13	0.692240E-05	0.865648E-05	0.345339E-05	0.435571E-05	0.534239E-05	0.232307E-05	0.286427E-05	0.345339E-05
14	0.699090E-05	0.874230E-05	0.348635E-05	0.439717E-05	0.539405E-05	0.234433E-05	0.289079E-05	0.348634E-05
15	0.706891E-05	0.884208E-05	0.352319E-05	0.444438E-05	0.545288E-05	0.236855E-05	0.292099E-05	0.352318E-05
16	0.715731E-05	0.895516E-05	0.356493E-05	0.449787E-05	0.551195E-05	0.239598E-05	0.295522E-05	0.356493E-05
17	0.725703E-05	0.908274E-05	0.361202E-05	0.455822E-05	0.559755E-05	0.242693E-05	0.299382E-05	0.361202E-05
18	0.736908E-05	0.922609E-05	0.366492E-05	0.462601E-05	0.567924E-05	0.246169E-05	0.303718E-05	0.366492E-05
19	0.749453E-05	0.938661E-05	0.372413E-05	0.470190E-05	0.577382E-05	0.250061E-05	0.308572E-05	0.372413E-05
20	0.756261E-05	0.947372E-05	0.375627E-05	0.474308E-05	0.585216E-05	0.252172E-05	0.311206E-05	0.375627E-05
21	0.763448E-05	0.956569E-05	0.379019E-05	0.478655E-05	0.587934E-05	0.254401E-05	0.313986E-05	0.379019E-05
22	0.771031E-05	0.966273E-05	0.382597E-05	0.483241E-05	0.593651E-05	0.256753E-05	0.316919E-05	0.382597E-05
23	0.779027E-05	0.976506E-05	0.386370E-05	0.488077E-05	0.599679E-05	0.259232E-05	0.320012E-05	0.386370E-05
24	0.787458E-05	0.987295E-05	0.390348E-05	0.493175E-05	0.606034E-05	0.261846E-05	0.323273E-05	0.390348E-05
25	0.796343E-05	0.998665E-05	0.394539E-05	0.498547E-05	0.612730E-05	0.264599E-05	0.326708E-05	0.394539E-05
26	0.805700E-05	0.101064E-04	0.398954E-05	0.504206E-05	0.619785E-05	0.267500E-05	0.330327E-05	0.398954E-05
27	0.815558E-05	0.102326E-04	0.403604E-05	0.510167E-05	0.627215E-05	0.270555E-05	0.334138E-05	0.403604E-05
28	0.825942E-05	0.103655E-04	0.408501E-05	0.516444E-05	0.635041E-05	0.273773E-05	0.338152E-05	0.408501E-05
29	0.836877E-05	0.105055E-04	0.413659E-05	0.520305E-05	0.643283E-05	0.277161E-05	0.342379E-05	0.413659E-05
30	0.848395E-05	0.106530E-04	0.419090E-05	0.530018E-05	0.651963E-05	0.280729E-05	0.3466830E-05	0.419090E-05
31	0.860527E-05	0.108083E-04	0.424810E-05	0.537351E-05	0.661106E-05	0.284487E-05	0.351518E-05	0.424810E-05
32	0.873308E-05	0.109719E-04	0.430836E-05	0.545075E-05	0.670737E-05	0.288445E-05	0.356457E-05	0.430836E-05
33	0.887775E-05	0.111444E-04	0.437184E-05	0.553214E-05	0.680884E-05	0.292615E-05	0.361659E-05	0.437184E-05
34	0.900969E-05	0.113261E-04	0.443875E-05	0.561792E-05	0.691580E-05	0.297010E-05	0.367143E-05	0.443875E-05
35	0.915936E-05	0.115178E-04	0.450929E-05	0.570836E-05	0.702857E-05	0.301644E-05	0.372924E-05	0.450929E-05
36	0.931732E-05	0.117201E-04	0.458373E-05	0.580379E-05	0.714757E-05	0.306533E-05	0.379024E-05	0.458373E-05
37	0.948409E-05	0.119337E-04	0.466232E-05	0.590655E-05	0.727322E-05	0.311695E-05	0.385464E-05	0.466232E-05
38	0.966029E-05	0.121593E-04	0.474533E-05	0.601099E-05	0.740595E-05	0.317147E-05	0.392267E-05	0.474533E-05
39	0.984656E-05	0.123979E-04	0.483309E-05	0.612351E-05	0.754627E-05	0.322911E-05	0.399458E-05	0.483309E-05
40	0.100437E-04	0.126505E-04	0.492598E-05	0.626426E-05	0.769481E-05	0.329011E-05	0.407070E-05	0.492598E-05
41	0.102526E-04	0.129180E-04	0.502435E-05	0.636785E-05	0.785211E-05	0.335471E-05	0.415130E-05	0.502434E-05
42	0.104741E-04	0.132017E-04	0.512864E-05	0.650249E-05	0.801891E-05	0.342320E-05	0.423677E-05	0.512864E-05
43	0.107088E-04	0.135025E-04	0.523920E-05	0.664427E-05	0.819745E-05	0.349580E-05	0.432736E-05	0.523920E-05
44	0.109582E-04	0.138220E-04	0.535662E-05	0.679484E-05	0.838354E-05	0.357290E-05	0.442357E-05	0.535662E-05
45	0.112224E-04	0.141606E-04	0.548410E-05	0.695436E-05	0.858521E-05	0.365458E-05	0.452549E-05	0.548410E-05
46	0.118009E-04	0.149019E-04	0.575332E-05	0.730359E-05	0.901813E-05	0.383338E-05	0.47481E-05	0.575332E-05
47	0.124522E-04	0.157366E-04	0.605983E-05	0.769671E-05	0.950851E-05	0.403462E-05	0.499974E-05	0.605983E-05
48	0.131737E-04	0.166612E-04	0.639927E-05	0.813207E-05	0.100516E-04	0.425747E-05	0.527784E-05	0.639927E-05
49	0.139622E-04	0.176720E-04	0.6677023E-05	0.860789E-05	0.106453E-04	0.45098E-05	0.558175E-05	0.677023E-05
50	0.143804E-04	0.182082E-04	0.696693E-05	0.886020E-05	0.109600E-04	0.463011E-05	0.574290E-05	0.696693E-05
51	0.148120E-04	0.187615E-04	0.716991E-05	0.912058E-05	0.112849E-04	0.476335E-05	0.590919E-05	0.716991E-05
52	0.152579E-04	0.193331E-04	0.737959E-05	0.938954E-05	0.116205E-04	0.490098E-05	0.608096E-05	0.737959E-05
53	0.157169E-04	0.199216E-04	0.759543E-05	0.966642E-05	0.119660E-04	0.504266E-05	0.625778E-05	0.759542E-05
54	0.161904E-04	0.205287E-04	0.781808E-05	0.995205E-05	0.123224E-04	0.518880E-05	0.644018E-05	0.781808E-05
55	0.166710E-04	0.211449E-04	0.804401E-05	0.102419E-04	0.126840E-04	0.533709E-05	0.662526E-05	0.804401E-05
56	0.171716E-04	0.217868E-04	0.827936E-05	0.105438E-04	0.130607E-04	0.549156E-05	0.681806E-05	0.827936E-05
57	0.176853E-04	0.224456E-04	0.852087E-05	0.108536E-04	0.134473E-04	0.565007E-05	0.701590E-05	0.852087E-05
58	0.182147E-04	0.231244E-04	0.876971E-05	0.111729E-04	0.138457E-04	0.581339E-05	0.721973E-05	0.876971E-05
59	0.187558E-04	0.238183E-04	0.902406E-05	0.114992E-04	0.142529E-04	0.598033E-05	0.742809E-05	0.902406E-05
60	0.193208E-04	0.245429E-04	0.928963E-05	0.118399E-04	0.146781E-04	0.615462E-05	0.764563E-05	0.928963E-05
61	0.198964E-04	0.252811E-04	0.956016E-05	0.121870E-04	0.151122E-04	0.633216E-05	0.786724E-05	0.956016E-05
62	0.204955E-04	0.260494E-04	0.984171E-05	0.125482E-04	0.155620E-04	0.651694E-05	0.809787E-05	0.984171E-05
63	0.211090E-04	0.268363E-04	0.101300E-04	0.129181E-04	0.160236E-04	0.670615E-05	0.833403E-05	0.101300E-04
64	0.217440E-04	0.276507E-04	0.104284E-04	0.133010E-04	0.165014E-04	0.690198E-05	0.857847E-05	0.104284E-04
65	0.223983E-04	0.284899E-04	0.107359E-04	0.136954E-04	0.169937E-04	0.710375E-05	0.883032E-05	0.107359E-04
66	0.237655E-04	0.302435E-04	0.113783E-04	0.145197E-04	0.180223E-04	0.752531E-05	0.935651E-05	0.113783E-04
67	0.244818E-04	0.311623E-04	0.117149E-04	0.149515E-04	0.185612E-04	0.774619E-05	0.963221E-05	0.117149E-04
68	0.252198E-04	0.321090E-04	0.120616E-04	0.153964E-04	0.191165E-04	0.797372E-05	0.991622E-05	0.120616E-04

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	JNU							
1	0.131026E-09	0.131026E-09	0.131026E-09	0.274951E-04	0.220467E-04	0.178787E-04	0.149344E-04	0.129553E-04
2	0.252774E-09	0.252774E-09	0.252774E-09	0.274955E-04	0.220469E-04	0.178787E-04	0.149345E-04	0.129553E-04
3	0.262448E-09	0.262448E-09	0.262448E-09	0.275213E-04	0.220586E-04	0.178842E-04	0.149371E-04	0.129567E-04
4	0.286325E-09	0.286325E-09	0.286325E-09	0.299416E-04	0.227616E-04	0.182389E-04	0.151226E-04	0.130589E-04
5	0.298440E-09	0.298440E-09	0.298440E-09	0.298440E-09	0.296035E-04	0.231040E-04	0.184183E-04	0.152198E-04
6	0.316710E-09	0.316710E-09	0.316710E-09	0.316710E-09	0.305465E-04	0.236028E-04	0.186847E-04	0.153663E-04
7	0.344498E-09	0.344498E-09	0.344498E-09	0.344498E-09	0.318760E-04	0.243246E-04	0.190782E-04	0.155864E-04
8	0.387333E-09	0.387333E-09	0.387333E-09	0.387333E-09	0.372737E-04	0.253613E-04	0.196568E-04	0.159162E-04
9	0.454671E-09	0.454671E-09	0.454671E-09	0.454671E-09	0.362699E-04	0.268377E-04	0.205035E-04	0.164089E-04
10	0.502339E-09	0.502339E-09	0.502339E-09	0.502339E-09	0.378625E-04	0.277909E-04	0.210622E-04	0.167392E-04
11	0.563345E-09	0.563345E-09	0.563345E-09	0.563345E-09	0.397073E-04	0.289206E-04	0.217353E-04	0.171420E-04
12	0.642146E-09	0.642146E-09	0.642146E-09	0.642146E-09	0.418358E-04	0.302566E-04	0.225451E-04	0.176325E-04
13	0.744973E-09	0.744973E-09	0.744973E-09	0.744973E-09	0.442818E-04	0.318327E-04	0.235182E-04	0.182298E-04
14	0.880683E-09	0.880683E-09	0.880683E-09	0.880683E-09	0.470824E-04	0.336883E-04	0.246683E-04	0.189565E-04
15	0.106199E-08	0.106199E-08	0.106199E-08	0.106199E-08	0.502778E-04	0.358681E-04	0.260870E-04	0.198404E-04
16	0.130749E-08	0.130749E-08	0.130749E-08	0.130749E-08	0.539134E-04	0.384244E-04	0.277651E-04	0.209154E-04
17	0.164466E-08	0.164466E-08	0.164466E-08	0.164466E-08	0.504010E-04	0.414178E-04	0.297745E-04	0.222229E-04
18	0.211486E-08	0.211486E-08	0.211486E-08	0.211486E-08	0.572212E-04	0.449194E-04	0.321800E-04	0.238140E-04
19	0.278122E-08	0.278122E-08	0.278122E-08	0.278122E-08	0.603191E-04	0.490137E-04	0.350599E-04	0.257518E-04
20	0.321645E-08	0.321645E-08	0.321645E-08	0.321645E-08	0.709488E-04	0.513126E-04	0.367059E-04	0.268739E-04
21	0.374099E-08	0.374099E-08	0.374099E-08	0.374099E-08	0.740583E-04	0.537987E-04	0.385076E-04	0.281134E-04
22	0.437593E-08	0.437593E-08	0.437593E-08	0.437593E-08	0.773757E-04	0.564879E-04	0.404604E-04	0.294832E-04
23	0.514798E-08	0.514798E-08	0.514798E-08	0.514798E-08	0.809184E-04	0.593981E-04	0.426413E-04	0.309979E-04
24	0.609109E-08	0.609109E-08	0.609109E-08	0.609109E-08	0.847061E-04	0.625492E-04	0.450906E-04	0.326739E-04
25	0.724836E-08	0.724836E-08	0.724836E-08	0.724836E-08	0.887602E-04	0.659631E-04	0.476062E-04	0.345297E-04
26	0.867515E-08	0.867515E-08	0.867515E-08	0.867515E-08	0.910543E-04	0.696644E-04	0.504553E-04	0.365860E-04
27	0.104425E-07	0.104425E-07	0.104425E-07	0.104425E-07	0.977693E-04	0.736806E-04	0.535834E-04	0.388666E-04
28	0.126421E-07	0.126421E-07	0.126421E-07	0.126421E-07	0.102782E-03	0.780425E-04	0.570205E-04	0.413983E-04
29	0.153931E-07	0.153931E-07	0.153931E-07	0.153931E-07	0.108179E-03	0.827849E-04	0.608007E-04	0.442116E-04
30	0.188501E-07	0.188501E-07	0.188501E-07	0.188501E-07	0.113997E-03	0.879464E-04	0.649621E-04	0.473412E-04
31	0.232156E-07	0.232156E-07	0.232156E-07	0.232156E-07	0.120280E-03	0.935711E-04	0.695481E-04	0.508272E-04
32	0.287554E-07	0.287554E-07	0.287554E-07	0.287554E-07	0.170703E-03	0.997082E-04	0.746079E-04	0.547149E-04
33	0.358198E-07	0.358198E-07	0.358198E-07	0.358198E-07	0.134430E-03	0.106413E-03	0.801970E-04	0.590565E-04
34	0.448729E-07	0.448729E-07	0.448729E-07	0.448729E-07	0.142409E-03	0.113748E-03	0.863791E-04	0.639123E-04
35	0.565327E-07	0.565327E-07	0.565327E-07	0.565327E-07	0.151074E-03	0.121785E-03	0.932265E-04	0.693517E-04
36	0.716131E-07	0.716131E-07	0.716131E-07	0.716131E-07	0.160499E-03	0.130605E-03	0.100822E-03	0.754547E-04
37	0.912818E-07	0.912818E-07	0.912818E-07	0.912818E-07	0.170763E-03	0.140297E-03	0.109621E-03	0.823139E-04
38	0.116987E-06	0.116987E-06	0.116987E-06	0.116987E-06	0.161698E-06	0.150965E-03	0.118651E-03	0.900361E-04
39	0.150784E-06	0.150784E-06	0.150784E-06	0.150784E-06	0.194179E-03	0.162724E-03	0.129115E-03	0.987452E-04
40	0.195481E-06	0.195481E-06	0.195481E-06	0.195481E-06	0.207547E-03	0.175708E-03	0.140796E-03	0.108585E-03
41	0.254877E-06	0.254877E-06	0.254877E-06	0.254877E-06	0.221284E-03	0.190065E-03	0.153855E-03	0.119720E-03
42	0.334244E-06	0.334244E-06	0.334244E-06	0.334244E-06	0.292299E-03	0.205959E-03	0.168474E-03	0.132340E-03
43	0.440710E-06	0.440710E-06	0.440710E-06	0.440710E-06	0.255829E-03	0.223570E-03	0.184855E-03	0.146660E-03
44	0.584363E-06	0.584363E-06	0.584363E-06	0.584363E-06	0.275153E-03	0.243100E-03	0.203228E-03	0.162923E-03
45	0.778397E-06	0.778397E-06	0.778397E-06	0.778397E-06	0.296299E-03	0.264710E-03	0.223808E-03	0.181387E-03
46	0.140079E-05	0.140079E-05	0.140079E-05	0.140079E-05	0.345124E-03	0.315378E-03	0.272877E-03	0.226244E-03
47	0.255901E-05	0.255901E-05	0.255901E-05	0.255901E-05	0.474003E-03	0.377725E-03	0.334583E-03	0.284019E-03
48	0.468358E-05	0.468358E-05	0.468358E-05	0.468358E-05	0.473770E-03	0.453158E-03	0.410935E-03	0.357261E-03
49	0.849691E-05	0.849691E-05	0.849691E-05	0.849691E-05	0.555187E-03	0.543015E-03	0.503907E-03	0.448543E-03
50	0.113749E-04	0.113749E-04	0.113749E-04	0.113749E-04	0.603085E-03	0.593622E-03	0.557079E-03	0.501599E-03
51	0.151298E-04	0.151298E-04	0.151298E-04	0.151298E-04	0.648308E-03	0.647748E-03	0.614510E-03	0.559533E-03
52	0.200018E-04	0.200018E-04	0.200018E-04	0.200018E-04	0.691989E-03	0.705713E-03	0.676587E-03	0.622775E-03
53	0.262593E-04	0.262593E-04	0.262593E-04	0.262593E-04	0.752975E-03	0.767515E-03	0.743388E-03	0.691496E-03
54	0.342590E-04	0.342590E-04	0.342590E-04	0.342590E-04	0.808948E-03	0.833377E-03	0.815182E-03	0.766018E-03
55	0.442371E-04	0.442371E-04	0.442371E-04	0.442371E-04	0.869011E-03	0.902458E-03	0.891176E-03	0.845678E-03
56	0.569285E-04	0.569285E-04	0.569285E-04	0.569285E-04	0.971997E-03	0.976512E-03	0.973245E-03	0.932383E-03
57	0.727408E-04	0.727408E-04	0.727408E-04	0.727408E-04	0.998076E-03	0.105477E-02	0.106068E-02	0.102555E-02
58	0.923926E-04	0.923926E-04	0.923926E-04	0.923926E-04	0.106757E-02	0.113763E-02	0.115392E-02	0.112570E-02
59	0.116460E-03	0.116460E-03	0.116460E-03	0.116460E-03	0.114004E-02	0.122461E-02	0.125254E-02	0.123247E-02
60	0.146406E-03	0.146406E-03	0.146406E-03	0.146406E-03	0.121710E-02	0.131765E-02	0.135870E-02	0.134820E-02
61	0.182555E-03	0.182555E-03	0.182555E-03	0.182555E-03	0.129705E-02	0.141478E-02	0.147031E-02	0.147079E-02
62	0.226881E-03	0.226881E-03	0.226881E-03	0.226881E-03	0.138165E-02	0.151814E-02	0.158978E-02	0.160286E-02
63	0.280079E-03	0.280079E-03	0.280079E-03	0.280079E-03	0.146972E-02	0.162632E-02	0.171561E-02	0.174292E-02
64	0.344255E-03	0.344255E-03	0.344255E-03	0.344255E-03	0.156228E-02	0.174061E-02	0.184930E-02	0.189263E-02
65	0.420942E-03	0.420942E-03	0.420942E-03	0.420942E-03	0.165905E-02	0.186067E-02	0.199050E-02	0.205170E-02
66	0.619613E-03	0.619613E-03	0.619613E-03	0.619613E-03	0.196550E-02	0.211866E-02	0.229635E-02	0.239925E-02
67	0.746532E-03	0.746532E-03	0.746532E-03	0.746532E-03	0.197577E-02	0.225737E-02	0.246200E-02	0.258900E-02
68	0.895144E-03	0.895144E-03	0.895144E-03	0.895144E-03	0.209075E-02	0.240259E-02	0.263624E-02	0.286649E-02

NU=	0.458333E-00	0.500000E-00	0.541667E C0	0.593333E 00	0.625000E 00	0.666667E 00	0.708333E 00	0.750000E 00
	JNU	JNU	JNU	JNU	JNU	JNU	JNU	JNU
1	0.116646E-04	0.108320E-04	0.102853E-04	0.990355E-05	0.960602E-05	0.934198E-05	0.908219E-05	0.881209E-05
2	0.116646E-04	0.108320E-04	0.102853E-04	0.990356E-05	0.960602E-05	0.934198E-05	0.908219E-05	0.881216E-05
3	0.116654E-04	0.108324E-04	0.102856E-04	0.990375E-05	0.960616E-05	0.934209E-05	0.908228E-05	0.881228E-05
4	0.117255E-04	0.108704E-04	0.103112E-04	0.992209E-05	0.961988E-05	0.935271E-05	0.909068E-05	0.881891E-05
5	0.117588E-04	0.108919E-04	0.103259E-04	0.993270E-05	0.962787E-05	0.935890E-05	0.909559E-05	0.882286E-05
6	0.118102E-04	0.109252E-04	0.103489E-04	0.994933E-05	0.964040E-05	0.936862E-05	0.910330E-05	0.882907E-05
7	0.118895E-04	0.109770E-04	0.103847E-04	0.997534E-05	0.966003E-05	0.938387E-05	0.911539E-05	0.883880E-05
8	0.120112E-04	0.110572E-04	0.104404E-04	0.1010159E-04	0.969068E-05	0.940768E-05	0.913427E-05	0.885399E-05
9	0.121979E-04	0.111810E-04	0.105268E-04	0.100789E-04	0.973831E-05	0.944469E-05	0.916361E-05	0.887759E-05
10	0.123256E-04	0.112661E-04	0.105863E-04	0.1012124E-04	0.977116E-05	0.947021E-05	0.918382E-05	0.889384E-05
11	0.124834E-04	0.113716E-04	0.106602E-04	0.1017163E-04	0.981197E-05	0.950189E-05	0.920891E-05	0.891400E-05
12	0.126784E-04	0.115024E-04	0.107520E-04	0.102433E-04	0.986259E-05	0.954116E-05	0.923999E-05	0.893896E-05
13	0.129192E-04	0.116644E-04	0.108657E-04	0.103264E-04	0.992532E-05	0.958978E-05	0.927843E-05	0.896981E-05
14	0.132166E-04	0.118650E-04	0.110067E-04	0.104293E-04	0.100030E-04	0.964988E-05	0.932589E-05	0.900785E-05
15	0.135839E-04	0.121134E-04	0.111813E-04	0.105568E-04	0.100989E-04	0.972409E-05	0.938441E-05	0.905470E-05
16	0.140377E-04	0.124212E-04	0.113978E-04	0.107145E-04	0.102176E-04	0.981563E-05	0.945647E-05	0.911231E-05
17	0.145988E-04	0.128028E-04	0.116662E-04	0.107999E-04	0.103642E-04	0.992849E-05	0.954512E-05	0.918304E-05
18	0.152935E-04	0.132764E-04	0.119995E-04	0.111520E-04	0.105455E-04	0.100676E-04	0.965415E-05	0.926984E-05
19	0.161550E-04	0.138655E-04	0.124139E-04	0.114526E-04	0.107698E-04	0.102393E-04	0.978826E-05	0.937632E-05
20	0.166610E-04	0.142123E-04	0.126578E-04	0.116292E-04	0.109013E-04	0.103397E-04	0.986649E-05	0.943829E-05
21	0.172255E-04	0.145998E-04	0.129305E-04	0.118264E-04	0.110479E-04	0.104514E-04	0.995332E-05	0.950696E-05
22	0.178559E-04	0.150333E-04	0.132354E-04	0.120468E-04	0.112114E-04	0.105757E-04	0.100498E-04	0.958310E-05
23	0.185606E-04	0.155188E-04	0.135770E-04	0.122933E-04	0.113939E-04	0.107141E-04	0.101570E-04	0.966757E-05
24	0.193490E-04	0.160631E-04	0.139600E-04	0.125693E-04	0.115980E-04	0.108686E-04	0.102763E-04	0.976137E-05
25	0.202321E-04	0.166741E-04	0.143901E-04	0.128790E-04	0.118265E-04	0.110411E-04	0.104093E-04	0.986562E-05
26	0.212226E-04	0.173610E-04	0.148738E-04	0.122270E-04	0.120826E-04	0.112340E-04	0.105576E-04	0.998164E-05
27	0.223350E-04	0.181345E-04	0.154189E-04	0.136186E-04	0.123704E-04	0.114501E-04	0.107233E-04	0.101109E-04
28	0.235861E-04	0.190070E-04	0.160341E-04	0.140603E-04	0.126943E-04	0.116928E-04	0.109087E-04	0.102552E-04
29	0.249955E-04	0.199930E-04	0.167301E-04	0.155969E-04	0.130597E-04	0.119568E-04	0.111168E-04	0.104167E-04
30	0.265860E-04	0.211095E-04	0.175193E-04	0.151255E-04	0.134730E-04	0.122738E-04	0.113509E-04	0.105977E-04
31	0.283842E-04	0.223766E-04	0.184163E-04	0.157685E-04	0.139419E-04	0.126223E-04	0.116148E-04	0.108012E-04
32	0.304212E-04	0.238181E-04	0.194387E-04	0.165013E-04	0.144754E-04	0.130178E-04	0.119134E-04	0.110306E-04
33	0.327335E-04	0.254642E-04	0.206073E-04	0.173392E-04	0.150846E-04	0.134683E-04	0.122524E-04	0.112902E-04
34	0.353643E-04	0.273418E-04	0.219474E-04	0.193006E-04	0.157829E-04	0.139834E-04	0.126389E-04	0.115851E-04
35	0.383645E-04	0.294975E-04	0.234891E-04	0.194079E-04	0.165865E-04	0.145749E-04	0.130814E-04	0.119215E-04
36	0.417946E-04	0.319771E-04	0.252690E-04	0.207688E-04	0.175153E-04	0.152573E-04	0.135903E-04	0.123071E-04
37	0.457260E-04	0.343838E-04	0.273731E-04	0.221750E-04	0.185940E-04	0.160487E-04	0.141789E-04	0.127514E-04
38	0.502441E-04	0.381501E-04	0.297311E-04	0.239091E-04	0.198529E-04	0.169712E-04	0.148633E-04	0.132664E-04
39	0.554501E-04	0.419965E-04	0.325533E-04	0.259491E-04	0.213299E-04	0.180527E-04	0.156661E-04	0.138670E-04
40	0.614652E-04	0.464789E-04	0.358197E-04	0.283337E-04	0.230720E-04	0.193284E-04	0.166070E-04	0.145723E-04
41	0.684322E-04	0.517197E-04	0.396893E-04	0.311643E-04	0.251385E-04	0.208425E-04	0.177249E-04	0.154063E-04
42	0.765245E-04	0.578664E-04	0.442635E-04	0.345293E-04	0.276035E-04	0.226508E-04	0.190593E-04	0.163999E-04
43	0.859401E-04	0.650966E-04	0.496914E-04	0.395483E-04	0.305601E-04	0.248246E-04	0.206639E-04	0.175930E-04
44	0.969183E-04	0.736245E-04	0.561554E-04	0.413704E-04	0.341262E-04	0.274545E-04	0.226072E-04	0.190371E-04
45	0.109732E-03	0.837033E-04	0.638769E-04	0.491799E-04	0.384989E-04	0.306563E-04	0.249780E-04	0.207991E-04
46	0.142185E-03	0.109774E-03	0.841894E-04	0.664949E-04	0.501546E-04	0.393844E-04	0.314761E-04	0.256406E-04
47	0.186317E-03	0.146157E-03	0.113330E-03	0.874653E-04	0.676141E-04	0.526400E-04	0.414549E-04	0.331288E-04
48	0.245432E-03	0.196386E-03	0.154702E-03	0.170667E-03	0.937121E-04	0.728341E-04	0.569082E-04	0.448713E-04
49	0.323014E-03	0.262419E-03	0.212237E-03	0.168186E-03	0.132083E-03	0.103256E-03	0.806867E-04	0.632643E-04
50	0.369737E-03	0.305894E-03	0.248340E-03	0.198653E-03	0.157208E-03	0.123574E-03	0.968566E-04	0.759721E-04
51	0.422032E-03	0.353518E-03	0.289908E-03	0.274265E-03	0.187024E-03	0.148042E-03	0.116597E-03	0.916812E-04
52	0.480363E-03	0.406571E-03	0.337456E-03	0.275574E-03	0.222112E-03	0.177253E-03	0.140496E-03	0.110949E-03
53	0.545087E-03	0.466486E-03	0.391469E-03	0.373115E-03	0.263055E-03	0.211821E-03	0.169172E-03	0.134379E-03
54	0.616635E-03	0.533406E-03	0.454274E-03	0.377458E-03	0.310457E-03	0.252382E-03	0.203282E-03	0.162623E-03
55	0.694753E-03	0.607294E-03	0.520611E-03	0.478896E-03	0.364735E-03	0.299446E-03	0.243400E-03	0.196296E-03
56	0.781199E-03	0.689778E-03	0.597379E-03	0.508791E-03	0.427132E-03	0.354158E-03	0.290588E-03	0.236387E-03
57	0.875833E-03	0.780953E-03	0.683079E-03	0.587617E-03	0.498245E-03	0.417202E-03	0.345592E-03	0.283677E-03
58	0.979282E-03	0.881514E-03	0.778475E-03	0.676197E-03	0.578951E-03	0.489489E-03	0.409341E-03	0.339100E-03
59	0.109151E-02	0.991629E-03	0.883938E-03	0.775085E-03	0.669949E-03	0.571831E-03	0.482724E-03	0.403595E-03
60	0.121497E-02	0.111369E-02	0.100177E-02	0.886467E-03	0.773298E-03	0.666154E-03	0.567536E-03	0.478829E-03
61	0.134793E-02	0.124633E-02	0.113099E-02	0.109777E-02	0.888813E-03	0.772609E-03	0.664204E-03	0.565443E-03
62	0.149320E-02	0.139233E-02	0.127432E-02	0.114761E-02	0.101897E-02	0.893543E-03	0.774941E-03	0.665517E-03
63	0.164956E-02	0.155072E-02	0.143110E-02	0.129967E-02	0.116382E-02	0.102932E-02	0.900387E-03	0.779916E-03
64	0.181896E-02	0.172358E-02	0.160348E-02	0.146814E-02	0.132555E-02	0.118212E-02	0.104271E-02	0.910785E-03
65	0.200132E-02	0.191096E-02	0.179172E-02	0.165351E-02	0.150492E-02	0.135298E-02	0.120318E-02	0.105960E-02
66	0.240750E-02	0.233269E-02	0.221995E-02	0.207991E-02	0.192217E-02	0.175498E-02	0.158512E-02	0.141793E-02
67	0.263322E-02	0.256930E-02	0.246259E-02	0.223298E-02	0.216349E-02	0.198995E-02	0.181076E-02	0.163191E-02
68	0.287457E-02	0.282385E-02	0.272531E-02	0.259000E-02	0.242831E-02	0.224958E-02	0.206183E-02	0.187168E-02

NU	0.791667E 00	0.833333E 00	0.875000E 00	0.916667E 00	0.958333E 00	1.000000E 00	0.111111E-00	0.118827E-00
	JNU	JNU	JNU	JNU	JNU	JNU	JNU	JNU
1	0.852662E-05	0.822643E-05	0.791521E-05	0.759792E-05	0.727970E-05	0.696526E-05	0.519741E-04	0.558869E-04
2	0.852662E-05	0.822643E-05	0.791521E-05	0.759792E-05	0.727970E-05	0.696526E-05	0.519742E-04	0.558871E-04
3	0.852667E-05	0.822647E-05	0.791525E-05	0.759795E-05	0.727973E-05	0.696528E-05	0.519857E-04	0.558971E-04
4	0.853217E-05	0.823098E-05	0.791897E-05	0.740104E-05	0.728231E-05	0.696744E-05	0.526942E-04	0.565291E-04
5	0.853538E-05	0.823361E-05	0.792114E-05	0.740285E-05	0.728381E-05	0.696871E-05	0.530454E-04	0.568454E-04
6	0.854043E-05	0.823776E-05	0.792456E-05	0.740569E-05	0.728618E-05	0.697069E-05	0.535613E-04	0.573123E-04
7	0.854835E-05	0.824425E-05	0.792993E-05	0.741014E-05	0.728990E-05	0.697380E-05	0.543151E-04	0.579981E-04
8	0.856707E-05	0.825439E-05	0.793829E-05	0.741708E-05	0.729569E-05	0.697866E-05	0.554092E-04	0.589997E-04
9	0.857989E-05	0.827012E-05	0.795127E-05	0.742786E-05	0.730468E-05	0.698619E-05	0.569849E-04	0.604532E-04
10	0.859310E-05	0.828094E-05	0.796021E-05	0.743352E-05	0.731085E-05	0.699137E-05	0.580109E-04	0.614055E-04
11	0.860948E-05	0.829436E-05	0.797127E-05	0.744444E-05	0.731851E-05	0.699777E-05	0.592334E-04	0.625457E-04
12	0.862975E-05	0.831095E-05	0.798495E-05	0.765579E-05	0.732796E-05	0.700569E-05	0.606859E-04	0.639076E-04
13	0.865477E-05	0.833143E-05	0.800183E-05	0.766978E-05	0.733962E-05	0.701545E-05	0.624062E-04	0.655298E-04
14	0.868562E-05	0.835666E-05	0.802260E-05	0.768699E-05	0.735395E-05	0.702745E-05	0.644364E-04	0.674565E-04
15	0.872356E-05	0.838766E-05	0.804812E-05	0.770812E-05	0.737154E-05	0.704217E-05	0.668227E-04	0.697369E-04
16	0.877015E-05	0.842566E-05	0.807939E-05	0.773400E-05	0.739308E-05	0.706018E-05	0.696151E-04	0.724261E-04
17	0.882727E-05	0.847226E-05	0.811765E-05	0.776562E-05	0.741937E-05	0.708216E-05	0.728666E-04	0.755842E-04
18	0.889732E-05	0.852920E-05	0.816437E-05	0.790421E-05	0.745143E-05	0.710893E-05	0.766321E-04	0.792760E-04
19	0.898287E-05	0.859878E-05	0.822136E-05	0.751222E-05	0.749045E-05	0.714150E-05	0.809668E-04	0.835702E-04
20	0.903260E-05	0.863912E-05	0.825436E-05	0.778748E-05	0.751300E-05	0.716030E-05	0.833640E-04	0.859647E-04
21	0.908764E-05	0.868371E-05	0.829080E-05	0.790842E-05	0.753786E-05	0.718012E-05	0.859224E-04	0.885356E-04
22	0.914857E-05	0.873300E-05	0.833104E-05	0.794152E-05	0.756526E-05	0.720385E-05	0.886478E-04	0.912916E-04
23	0.921605E-05	0.878751E-05	0.837548E-05	0.797804E-05	0.759548E-05	0.722900E-05	0.915457E-04	0.942412E-04
24	0.929083E-05	0.884783E-05	0.842460E-05	0.801835E-05	0.762880E-05	0.725671E-05	0.946213E-04	0.973930E-04
25	0.937378E-05	0.891461E-05	0.847889E-05	0.806286E-05	0.766555E-05	0.728725E-05	0.978786E-04	0.100755E-03
26	0.946588E-05	0.898862E-05	0.853897E-05	0.811205E-05	0.770612E-05	0.732094E-05	0.101321E-03	0.104334E-03
27	0.956828E-05	0.907074E-05	0.860551E-05	0.816645E-05	0.775093E-05	0.735811E-05	0.104953E-03	0.108137E-03
28	0.968229E-05	0.916197E-05	0.867929E-05	0.872667E-05	0.780047E-05	0.739915E-05	0.108775E-03	0.112171E-03
29	0.980948E-05	0.926349E-05	0.876123E-05	0.879342E-05	0.785532E-05	0.744453E-05	0.112790E-03	0.116442E-03
30	0.995167E-05	0.937668E-05	0.885239E-05	0.876755E-05	0.791610E-05	0.749476E-05	0.116999E-03	0.120956E-03
31	0.101110E-04	0.950319E-05	0.895401E-05	0.850010E-05	0.798361E-05	0.755046E-05	0.121405E-03	0.125716E-03
32	0.102901E-04	0.964495E-05	0.906758E-05	0.854196E-05	0.805874E-05	0.761235E-05	0.126008E-03	0.130728E-03
33	0.104921E-04	0.980428E-05	0.919486E-05	0.864475E-05	0.814255E-05	0.768126E-05	0.130811E-03	0.135996E-03
34	0.107206E-04	0.998402E-05	0.933800E-05	0.876003E-05	0.823632E-05	0.775820E-05	0.135817E-03	0.141526E-03
35	0.109804E-04	0.101876E-04	0.949958E-05	0.889878E-05	0.834158E-05	0.784439E-05	0.141031E-03	0.147322E-03
36	0.112771E-04	0.104191E-04	0.968276E-05	0.903641E-05	0.846020E-05	0.794128E-05	0.146462E-03	0.153392E-03
37	0.116176E-04	0.106840E-04	0.989144E-05	0.970288E-05	0.859447E-05	0.805056E-05	0.152121E-03	0.159746E-03
38	0.120108E-04	0.109885E-04	0.101305E-04	0.979286E-05	0.874720E-05	0.817469E-05	0.158024E-03	0.166396E-03
39	0.124677E-04	0.113408E-04	0.104059E-04	0.961096E-05	0.892190E-05	0.831613E-05	0.164192E-03	0.173360E-03
40	0.130021E-04	0.117514E-04	0.107256E-04	0.969298E-05	0.912298E-05	0.8478735E-05	0.170653E-03	0.180662E-03
41	0.136320E-04	0.122333E-04	0.110991E-04	0.91563E-04	0.935605E-05	0.866567E-05	0.177440E-03	0.188330E-03
42	0.143801E-04	0.128034E-04	0.115392E-04	0.1015003E-04	0.962824E-05	0.888355E-05	0.184591E-03	0.196401E-03
43	0.152759E-04	0.134837E-04	0.120621E-04	0.1019072E-04	0.994877E-05	0.913901E-05	0.192146E-03	0.204914E-03
44	0.163580E-04	0.143028E-04	0.126891E-04	0.113930E-04	0.103297E-04	0.944121E-05	0.200150E-03	0.213915E-03
45	0.176763E-04	0.152980E-04	0.134482E-04	0.119785E-04	0.107886E-04	0.980208E-05	0.208598E-03	0.223404E-03
46	0.212980E-04	0.180251E-04	0.155193E-04	0.135669E-04	0.120181E-04	0.107674E-04	0.227255E-03	0.244315E-03
47	0.269190E-04	0.222580E-04	0.187247E-04	0.160124E-04	0.139003E-04	0.122305E-04	0.248555E-03	0.268176E-03
48	0.358109E-04	0.289885E-04	0.238304E-04	0.199027E-04	0.168830E-04	0.145349E-04	0.272476E-03	0.295006E-03
49	0.499389E-04	0.397978E-04	0.320902E-04	0.262212E-04	0.217318E-04	0.182742E-04	0.299026E-03	0.324844E-03
50	0.598331E-04	0.474526E-04	0.379907E-04	0.307636E-04	0.252315E-04	0.209779E-04	0.313250E-03	0.340852E-03
51	0.722005E-04	0.571125E-04	0.454961E-04	0.365779E-04	0.297323E-04	0.244657E-04	0.327957E-03	0.357406E-03
52	0.875506E-04	0.692293E-04	0.549966E-04	0.439941E-04	0.355081E-04	0.289620E-04	0.343231E-03	0.374612E-03
53	0.106452E-03	0.843203E-04	0.669494E-04	0.514073E-04	0.428933E-04	0.347456E-04	0.359043E-03	0.392437E-03
54	0.129531E-03	0.102969E-03	0.818835E-04	0.6522905E-04	0.421576E-04	0.375432E-03	0.410925E-03	
55	0.157411E-03	0.125783E-03	0.100368E-03	0.801414E-04	0.641604E-04	0.515987E-04	0.392158E-03	0.429809E-03
56	0.191011E-03	0.153607E-03	0.123172E-03	0.986693E-04	0.71086E-04	0.635936E-04	0.409648E-03	0.449567E-03
57	0.231127E-03	0.187229E-03	0.151051E-03	0.121575E-03	0.977830E-04	0.787236E-04	0.427683E-03	0.469953E-03
58	0.278686E-03	0.227553E-03	0.184876E-03	0.149679E-03	0.120942E-03	0.976767E-04	0.446341E-03	0.491056E-03
59	0.334647E-03	0.275542E-03	0.225588E-03	0.194385E-03	0.149438E-03	0.121240E-03	0.465494E-03	0.512733E-03
60	0.400561E-03	0.332634E-03	0.274522E-03	0.225426E-03	0.184400E-03	0.150440E-03	0.485561E-03	0.535454E-03
61	0.477223E-03	0.399728E-03	0.332637E-03	0.275288E-03	0.226807E-03	0.186227E-03	0.506085E-03	0.558707E-03
62	0.566583E-03	0.478651E-03	0.401639E-03	0.315055E-03	0.278136E-03	0.229965E-03	0.527513E-03	0.582995E-03
63	0.669679E-03	0.570559E-03	0.482762E-03	0.476004E-03	0.339663E-03	0.282906E-03	0.549533E-03	0.607966E-03
64	0.788614E-03	0.677502E-03	0.577987E-03	0.490035E-03	0.413201E-03	0.346767E-03	0.572393E-03	0.633901E-03
65	0.925047E-03	0.801272E-03	0.689192E-03	0.589064E-03	0.500663E-03	0.423423E-03	0.596013E-03	0.660710E-03
66	0.125740E-02	0.110634E-02	0.966548E-03	0.839020E-03	0.724120E-03	0.621659E-03	0.645581E-03	0.717005E-03
67	0.145802E-02	0.129249E-02	0.113764E-02	0.994889E-03	0.864958E-03	0.747988E-03	0.671657E-03	0.746636E-03
68	0.168441E-02	0.150401E-02	0.133337E-02	0.117442E-02	0.102826E-02	0.895383E-03	0.698586E-03	0.777249E-03

NU=	0.126543E-00	0.134259E-00	0.141975E-00	0.149691E-00	0.157407E-00	0.165123E-00	0.172839E-00	0.180556E-00
1	0.596970E-04	0.634060E-04	0.670169E-04	0.705329E-04	0.739573E-04	0.772935E-04	0.805440E-04	0.837115E-04
2	0.596971E-04	0.634061E-04	0.670170E-04	0.705330E-04	0.739574E-04	0.772935E-04	0.805441E-04	0.837116E-04
3	0.597059E-04	0.634138E-04	0.670237E-04	0.705389E-04	0.739626E-04	0.772981E-04	0.805481E-04	0.837151E-04
4	0.602693E-04	0.639161E-04	0.674715E-04	0.709382E-04	0.743190E-04	0.776164E-04	0.808327E-04	0.839699E-04
5	0.605538E-04	0.641718E-04	0.677013E-04	0.711448E-04	0.745047E-04	0.777834E-04	0.809830E-04	0.841053E-04
6	0.609757E-04	0.645525E-04	0.680447E-04	0.714545E-04	0.747860E-04	0.780354E-04	0.812106E-04	0.843108E-04
7	0.615983E-04	0.651171E-04	0.685556E-04	0.719175E-04	0.752032E-04	0.784150E-04	0.815543E-04	0.846224E-04
8	0.625131E-04	0.65959CE-04	0.693151E-04	0.776078E-04	0.758307E-04	0.789854E-04	0.820729E-04	0.850939E-04
9	0.638493E-04	0.671762E-04	0.704367E-04	0.736331E-04	0.767672E-04	0.798403E-04	0.828533E-04	0.858063E-04
10	0.647296E-04	0.679876E-04	0.711828E-04	0.743179E-04	0.773951E-04	0.804156E-04	0.833800E-04	0.862886E-04
11	0.657882E-04	0.689668E-04	0.720863E-04	0.751500E-04	0.781601E-04	0.811183E-04	0.840251E-04	0.868805E-04
12	0.670584E-04	0.701469E-04	0.731791E-04	0.761596E-04	0.790914E-04	0.819760E-04	0.848145E-04	0.876066E-04
13	0.685792E-04	0.715660E-04	0.744987E-04	0.773833E-04	0.802236E-04	0.830221E-04	0.857798E-04	0.884968E-04
14	0.703954E-04	0.732691E-04	0.760893E-04	0.798640E-04	0.815987E-04	0.842967E-04	0.869595E-04	0.895875E-04
15	0.725582E-04	0.753082E-04	0.780028E-04	0.806530E-04	0.832664E-04	0.858478E-04	0.883996E-04	0.909229E-04
16	0.751259E-04	0.777433E-04	0.802997E-04	0.878104E-04	0.852895E-04	0.877332E-04	0.901562E-04	0.925567E-04
17	0.781635E-04	0.806427E-04	0.830502E-04	0.854070E-04	0.877276E-04	0.900220E-04	0.922964E-04	0.945541E-04
18	0.817435E-04	0.840480E-04	0.863335E-04	0.885254E-04	0.906745E-04	0.927968E-04	0.949014E-04	0.969940E-04
19	0.859449E-04	0.881543E-04	0.902476E-04	0.922618E-04	0.942245E-04	0.961555E-04	0.980684E-04	0.999719E-04
20	0.883046E-04	0.904548E-04	0.924708E-04	0.943954E-04	0.962605E-04	0.980893E-04	0.998981E-04	0.101698E-03
21	0.908513E-04	0.929487E-04	0.948907E-04	0.967259E-04	0.984912E-04	0.100214E-03	0.101913E-03	0.103603E-03
22	0.935962E-04	0.956495E-04	0.975221E-04	0.992694E-04	0.100934E-03	0.102547E-03	0.104132E-03	0.105706E-03
23	0.965506E-04	0.985709E-04	0.100381E-03	0.102043E-03	0.103607E-03	0.105108E-03	0.106575E-03	0.108026E-03
24	0.997263E-04	0.101727E-03	0.103484E-03	0.105067E-03	0.106531E-03	0.107919E-03	0.109263E-03	0.110586E-03
25	0.103133E-03	0.105133E-03	0.106849E-03	0.108358E-03	0.109726E-03	0.111001E-03	0.112219E-03	0.113409E-03
26	0.106786E-03	0.108804E-03	0.110493E-03	0.111940E-03	0.113217E-03	0.114379E-03	0.115470E-03	0.116523E-03
27	0.110693E-03	0.112754E-03	0.114435E-03	0.115832E-03	0.117026E-03	0.118080E-03	0.119044E-03	0.119956E-03
28	0.114866E-03	0.116999E-03	0.118695E-03	0.120059E-03	0.121181E-03	0.122133E-03	0.122971E-03	0.123741E-03
29	0.119316E-03	0.121555E-03	0.123292E-03	0.124644E-03	0.125709E-03	0.126567E-03	0.127284E-03	0.127911E-03
30	0.124051E-03	0.126435E-03	0.128248E-03	0.129613E-03	0.130640E-03	0.131417E-03	0.132020E-03	0.132507E-03
31	0.129083E-03	0.131657E-03	0.133582E-03	0.134992E-03	0.136004E-03	0.136718E-03	0.137217E-03	0.137569E-03
32	0.134421E-03	0.137234E-03	0.139316E-03	0.140807E-03	0.141835E-03	0.142507E-03	0.142911E-03	0.143144E-03
33	0.140073E-03	0.143181E-03	0.145470E-03	0.147087E-03	0.148166E-03	0.148825E-03	0.149168E-03	0.149281E-03
34	0.146047E-03	0.149512E-03	0.152066E-03	0.153860E-03	0.155033E-03	0.155715E-03	0.156017E-03	0.156306E-03
35	0.152353E-03	0.156241E-03	0.159125E-03	0.161154E-03	0.162474E-03	0.163220E-03	0.163516E-03	0.163467E-03
36	0.159000E-03	0.163382E-03	0.166666E-03	0.168998E-03	0.170525E-03	0.171389E-03	0.171721E-03	0.171637E-03
37	0.165998E-03	0.170949E-03	0.174711E-03	0.177421E-03	0.179224E-03	0.180268E-03	0.180689E-03	0.180615E-03
38	0.173360E-03	0.178957E-03	0.183280E-03	0.186451E-03	0.188611E-03	0.189907E-03	0.190483E-03	0.190470E-03
39	0.181100E-03	0.187422E-03	0.192392E-03	0.196115E-03	0.198722E-03	0.200356E-03	0.201161E-03	0.201278E-03
40	0.189239E-03	0.196363E-03	0.202069E-03	0.205644E-03	0.209594E-03	0.211661E-03	0.212788E-03	0.213115E-03
41	0.197801E-03	0.205801E-03	0.212335E-03	0.217457E-03	0.221262E-03	0.223871E-03	0.225422E-03	0.226056E-03
42	0.206819E-03	0.215765E-03	0.223213E-03	0.229187E-03	0.233758E-03	0.237026E-03	0.239119E-03	0.240173E-03
43	0.216328E-03	0.226285E-03	0.234730E-03	0.241658E-03	0.247110E-03	0.251164E-03	0.253929E-03	0.255531E-03
44	0.226369E-03	0.237396E-03	0.246916E-03	0.254895E-03	0.261344E-03	0.266314E-03	0.269890E-03	0.272183E-03
45	0.236945E-03	0.249097E-03	0.259763E-03	0.268885E-03	0.276444E-03	0.282461E-03	0.286996E-03	0.290137E-03
46	0.260198E-03	0.274773E-03	0.287928E-03	0.299576E-03	0.309653E-03	0.318128E-03	0.325003E-03	0.330314E-03
47	0.286690E-03	0.303965E-03	0.319885E-03	0.334354E-03	0.347292E-03	0.358636E-03	0.368348E-03	0.376415E-03
48	0.316501E-03	0.336818E-03	0.355833E-03	0.373445E-03	0.389586E-03	0.404131E-03	0.417079E-03	0.428372E-03
49	0.349718E-03	0.373486E-03	0.396010E-03	0.417172E-03	0.436876E-03	0.4550403E-03	0.471609E-03	0.486526E-03
50	0.367565E-03	0.393216E-03	0.417655E-03	0.440758E-03	0.462418E-03	0.482549E-03	0.501081E-03	0.517959E-03
51	0.386024E-03	0.413627E-03	0.440057E-03	0.465179E-03	0.488878E-03	0.511059E-03	0.531645E-03	0.550576E-03
52	0.405224E-03	0.434873E-03	0.463392E-03	0.496635E-03	0.516476E-03	0.540814E-03	0.563561E-03	0.584650E-03
53	0.425131E-03	0.456922E-03	0.487630E-03	0.517098E-03	0.545193E-03	0.571801E-03	0.596827E-03	0.620193E-03
54	0.445793E-03	0.479823E-03	0.512822E-03	0.544625E-03	0.575078E-03	0.604083E-03	0.631508E-03	0.657276E-03
55	0.466918E-03	0.503258E-03	0.538630E-03	0.572855E-03	0.605777E-03	0.637263E-03	0.667197E-03	0.695483E-03
56	0.489030E-03	0.527804E-03	0.565675E-03	0.6042455E-03	0.637978E-03	0.672099E-03	0.704690E-03	0.735645E-03
57	0.511864E-03	0.553169E-03	0.593647E-03	0.613097E-03	0.671342E-03	0.708225E-03	0.743611E-03	0.777380E-03
58	0.535514E-03	0.579459E-03	0.622658E-03	0.664899E-03	0.705995E-03	0.745778E-03	0.784100E-03	0.820832E-03
59	0.559824E-03	0.606502E-03	0.652522E-03	0.697662E-03	0.741725E-03	0.784530E-03	0.825920E-03	0.865755E-03
60	0.585318E-03	0.634876E-03	0.683873E-03	0.720777E-03	0.779278E-03	0.825286E-03	0.869931E-03	0.913061E-03
61	0.611425E-03	0.663952E-03	0.716022E-03	0.767394E-03	0.817845E-03	0.867176E-03	0.915205E-03	0.961770E-03
62	0.638708E-03	0.694352E-03	0.749654E-03	0.804360E-03	0.858237E-03	0.911075E-03	0.962680E-03	0.101288E-02
63	0.666771E-03	0.725641E-03	0.784289E-03	0.842453E-03	0.899888E-03	0.956372E-03	0.101170E-02	0.106570E-02
64	0.695933E-03	0.758170E-03	0.820316E-03	0.882097E-03	0.943259E-03	0.100357E-02	0.106281E-02	0.112080E-02
65	0.726089E-03	0.791823E-03	0.857605E-03	0.973152E-03	0.988198E-03	0.105250E-02	0.111583E-02	0.117798E-02
66	0.789457E-03	0.862590E-03	0.936078E-03	0.100962E-02	0.108292E-02	0.115573E-02	0.122778E-02	0.129886E-02
67	0.822831E-03	0.899885E-03	0.977464E-03	0.105525E-02	0.113295E-02	0.121029E-02	0.128701E-02	0.136287E-02
68	0.857324E-03	0.938446E-03	0.102027E-02	0.110248E-02	0.118475E-02	0.126681E-02	0.134839E-02	0.142924E-02

